

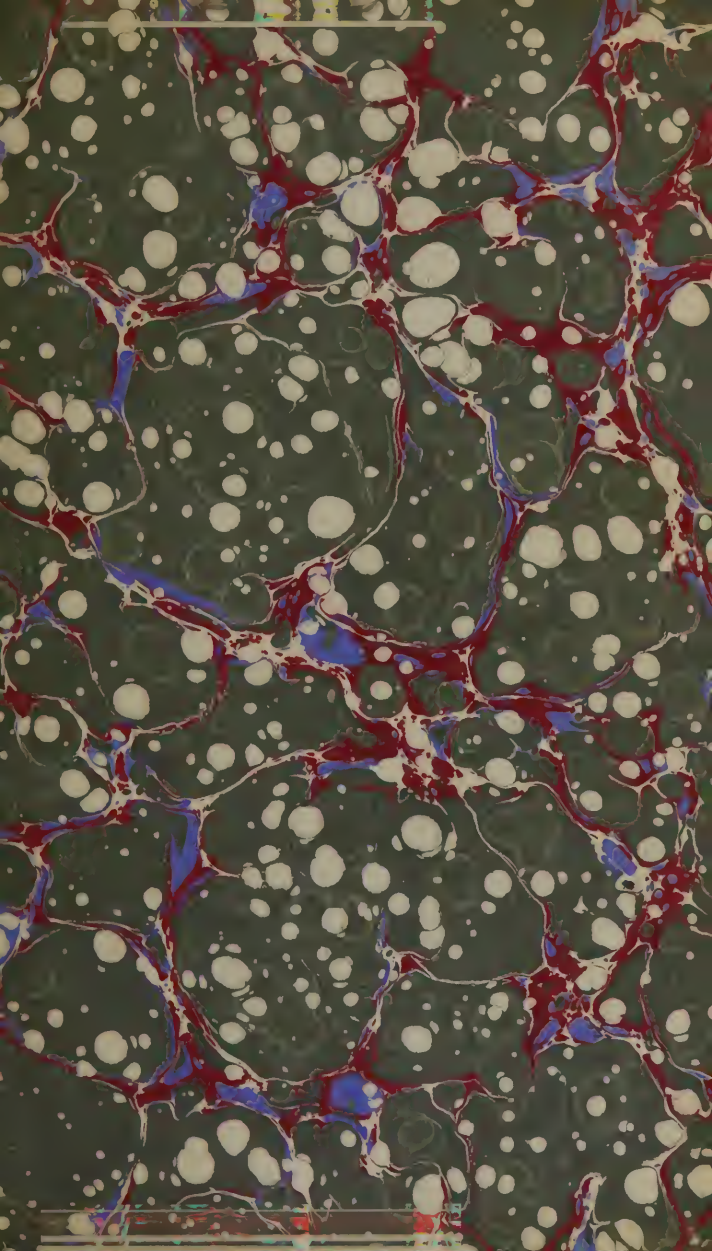
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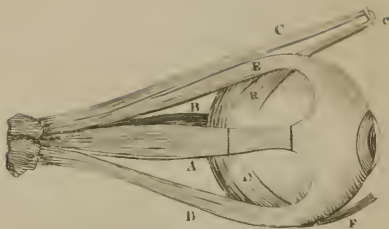
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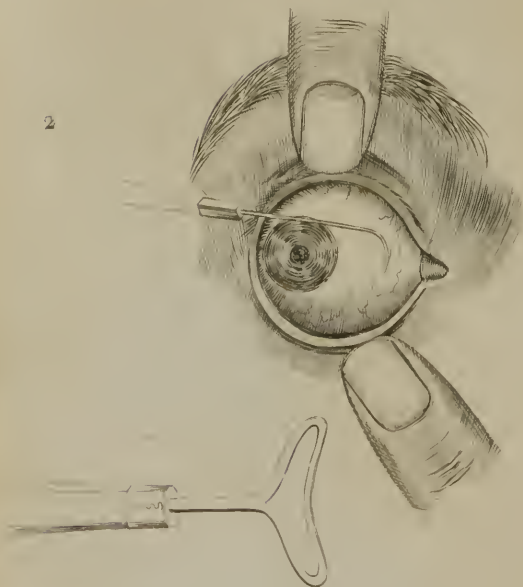
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TREATISE
ON
STRABISMUS, OR SQUINTING,
169.
AND THE
NEW MODE OF TREATMENT.

Illustrated by Engravings and Cases.

↓
BY JOHN H. DIX, M.D.

MEMBER OF THE MASSACHUSETTS MEDICAL SOCIETY.

Tum, ut hujus oculos in oculis habeas tuis.—PLAUTUS.

BOSTON
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EXPLANATION OF PLATE.

FIG. 1. A, rectus externus muscle. B, rectus internus. C, rectus superior. D, rectus inferior. E, superior oblique, or trochlearis. F, inferior oblique. *a*, insertion of superior oblique. *b*, insertion of inferior oblique. *c*, trochlea, or pulley of superior oblique.

TREATISE ON STRABISMUS.

ANATOMY AND FUNCTIONS OF THE MUSCLES OF THE GLOBE.

THE various movements of the globe of the eye, voluntary and involuntary, are effected by means of six distinct muscles. Its principal motions are performed by four of these, the straight or recti muscles, which arising together from the posterior part of the socket, run in a straight course forward, diverging from their point of origin until they embrace the globe itself, into which they are inserted at equal distances from each other.

The *rectus superior*, called also formerly *superbus* or *mirator*, has two separate origins, one from the upper side of the fibrous investment of the optic nerve, the other from the inner side of the sphenoidal fissure, between it and the foramen opticum. This muscle is the smallest in volume of all the recti muscles, longer than the *rectus internus*, but not so long as the *rectus externus*. It is supplied, in common with three other

muscles of the globe and the levator of the upper lid, by a branch from the third pair of nerves.

The *rectus inferior*, or *humilis*, arises from one tendon in common with the rectus internus and the rectus externus. This tendon or ligament of Zinn is inserted around the lower half of the circumference of the foramen opticum, and in a depression within the sphenoidal fissure. Almost immediately it separates into three portions, from the middle one of which this muscle originates. This muscle is supplied by the third pair of nerves.

The *rectus internus*, also anciently denominated *indiquatorius*, has two distinct origins, one from the tendon of Zinn, mentioned in the description of the rectus inferior, the other from the inner part of the fibrous lining of the foramen opticum, which last forms a continuation of the series of insertions of the rectus superior muscle. This muscle is shorter and much thicker than either of the other recti muscles. This muscle is also supplied by the third pair of nerves.

The *rectus externus*, *amatorius*, or *bibitorius*, also arises from a double origin; the lower furnished by the ligament of Zinn, the upper derived from the fibrous sheath of the external motor nerve, forming a continuation of the outer insertions of the superior rectus. The fibres of these two tendinous origins uniting, form an arch, from which the muscular fibres commence, and beneath which some of the nerves find a passage. This is the longest of the four recti muscles. One pair of nerves, the sixth, is bestowed upon this muscle alone.

The insertion of all the recti muscles is uniform. One muscle at each cardinal point is reflected on the globe, and becoming tendinous, the fibres of each diverge to meet those of the next, in such a manner as to form a white, firm, tendinous investinent (*tunica albuginea*) of the front of the globe, which is inserted into the sclerotic, all around the cornea in close proximity to it. Though varying as to length and thickness, the form of these muscles is the same, representing elongated, isosceles triangles, whose base is in front and apex behind.

The rectus superior, or upper straight muscle, being attached to the upper side of the globe, by its contraction draws it upward; the rectus inferior, attached on its under side, draws it downward; the rectus externus turns it outward; and the rectus internus inward, towards the nose. The equal combined action of any two adjacent muscles would of course give the eye a movement in the direction of the diagonal of these muscles; and by an unequal contraction of the two, a motion in any desired variation from the diagonal can be commanded. These muscles are of course sufficient for the voluntary movement of the globe in every possible direction.

In addition to these four recti muscles, two others also contribute to the motions of the globe—the superior oblique, or trochlearis, and the inferior oblique.

The *superior oblique*, or trochlearis, or patheticus, has a single origin from the fibrous investment of the optic nerve, between the rectus superior and the rectus

internus. It comes forward to the outer edge of the orbit, where the roof and inner wall form an angle, at which place, having already become tendinous, it runs through a small, cartilaginous loop, and is reflected at a very acute angle upon itself, in such a manner as to pass downward, outward, and slightly backward, beneath the rectus superior muscle, until it is inserted by a broad tendinous expansion posteriorly to the plane of the greatest perpendicular transverse diameter of the globe, and of course in a plane posterior to the insertion of the recti muscles. This is the longest muscle of the globe, and in form differs from all the others, being round rather than flat, and having its tendon, particularly that part which plays through the pulley or loop, rounded also. The fourth pair of nerves, considered by Sir Charles Bell to be one of the respiratory system, is bestowed upon this muscle alone.

The pulley or loop of the superior oblique is a small, cartilaginous band, describing about a quarter of a circle, and attached to its osseous foundation by ligamentous fibres, which give it a slight degree of mobility. A synovial membrane invests both the pulley and the tendon, and facilitates the sliding of the one upon the other. The action of this muscle must necessarily be referred from the point at which it is reflected, to the place of its insertion into the globe, and will rotate the globe inward and downward, carrying the pupil somewhat downward and outward, while its oblique direction from before backward enables it to bring the eye forward from the socket.

The *inferior oblique* is the only muscle of the globe which does not originate from the posterior part of the socket. It arises from the inner and outer part of the floor of this cavity, and consequently from the orbitary face of the superior maxillary bone. From its insertion it passes upward, outward, and somewhat backward, spreads itself into a broad fascia enveloping the under side of the globe, which it separates, first from the inferior rectus, and next from the rectus externus, and expanding into an aponeurosis, is united with the sclerotic near the outer edge of the superior rectus. Its insertion into the sclerotic is farther back than that of the superior oblique, and consequently much behind the insertions of the straight muscles. It is the shortest muscle of the globe, and to it is distributed, in common with the other muscles above named, the third pair of nerves. It rotates the globe in a direction opposite to that imparted to it by the superior oblique, and carries the pupil inward and upward.

The combined action of the two oblique muscles turns the pupil inward.

The cellular tissue upon which the eye is imbedded in the socket, and which fills up the interstices and invests the muscles, is of a peculiarly firm and elastic texture, and therefore well adapted to facilitate their action.

This muscular apparatus is attached to the globe, to enable us, by a voluntary effort, to direct the eyes to objects around us; to aid in the indication of certain passions and feelings; and also to provide for certain

involuntary rapid movements, essential sometimes to the safety, and always to the healthfulness of the organ. For the voluntary motions of the globe, it is evident that the four straight muscles are quite sufficient ; and to the oblique muscles, therefore, can be attributed only the involuntary movements.

As this classification of the muscles of the globe is one which has a practical bearing upon the operation recently introduced and successfully practised for the relief of strabismus, I quote with reference to it some very conclusive observations and experiments of Sir Charles Bell.

“ There is a motion of the eye-ball which, from its rapidity, has escaped observation. At the instant in which the eye-lids are closed, the eye-ball makes a movement which raises the cornea under the upper eye-lid.

“ If we fix one eye upon an object, and close the other eye with the finger in such a manner as to feel the convexity of the cornea through the eye-lid, when we shut the eye that is open, we shall feel that the cornea of the other eye is instantly elevated ; and that it thus rises and falls in sympathy with the eye that is closed and opened. This change of the position of the eye-ball takes place during the most rapid winking motions of the eye-lids. When a dog was deprived of the power of closing the eye-lids of one eye by the division of the nerve of the eye-lids, the eye did not cease to turn up when he was threatened, and when he winked with the eye-lids of the other side.

“ In patients deprived of the motion of the orbicularis palpebrarum by paralysis, we see every effort to close the eye-lids attended with a turning up of the eye-ball.

“ Nearly the same thing I observed in a girl whose eye-lids were attached to the surrounding skin, owing to a burn ; for the fore part of the eye-ball being completely uncovered, when she would have winked, instead of the eye-lids descending, the eye-balls were turned up, and the cornea was moistened by coming into contact with the mouths of the lachrymal ducts.

“ The purpose of this rapid insensible motion of the eye-ball will be understood on observing the form of the eye-lids and the place of the lachrymal gland. The margins of the eye-lids are flat, and when they meet they touch only at their outer edges, so that when closed there is a gutter left between them and the cornea. If the eye-balls were to remain without motion, the margins of the eye-lids would meet in such a manner on the surface of the cornea, that a certain portion would be left untouched, and the eye would have no power of clearing off what obscured the vision, at that principal part of the lucid cornea which is in the very axis of the eye ; and if the tears flowed, they would be left accumulated on the centre of the cornea, and winking, instead of clearing the eye, would suffuse it. To avoid these effects, and to sweep and clear the surface of the cornea, at the same time that the eye-lids are closed, the eye-ball revolves, and the cornea is rapidly elevated under the eye-lid.

“ Another effect of this motion of the eye-ball is to

procure the discharge from the lachrymal ducts ; for by the simultaneous ascent of the cornea, and the descent of the upper eye-lid, the membrane on which the ducts open is stretched, and the effect is like the elongation of the nipple, facilitating the discharge of tears.

“ By the double motion, the descent of the eye-lid and the ascent of the cornea at the same time, the rapidity with which the eye escapes from injury is increased.”

“ The different conditions of the eye, during the waking and sleeping state, remain to be considered. If we approach a person in disturbed sleep, when the eye-lids are a little apart, we shall not see the pupil nor the dark part of the eye, as we should were he awake, for the cornea is turned upward under the upper eye-lid. If a person be fainting, as insensibility comes over him the eyes cease to have speculation ; that is, they want direction, and are vacant, and presently the white part of the eye is disclosed by the revolving of the eye-ball upward. So it is on the approach of death ; for, although the eye-lids be open, the pupils are in part hid, being turned up with a seeming agony, which is the mark of increasing insensibility.

“ It will now be admitted, that the variety of motions to which the eye is subjected requires the complication of muscles which we find in the orbit ; and it must be obvious to the most casual observer, that unless these various offices and different conditions of the

eye be considered, it will be in vain to attempt an accurate classification of the muscles of the orbit."

"The oblique muscles of the eye stand contrasted with the recti in every respect ; in number, size, and direction. Yet it is a received opinion, that they antagonize the recti, and keep the eye suspended. To this opinion there are many objections. 1. In creatures where the eye is socketed on a cup of cartilage, and cannot retract, the oblique muscles are nevertheless present. 2. Where a powerful retractor muscle is bestowed in addition to the recti muscles, the oblique muscles have no additional magnitude given to them. 3. In matter of fact, the human eye cannot be retracted by the united action of the recti, as we see quadrupeds draw in their eyes, which is an argument against these muscles being retractors, and therefore against the obliqui being their opponents, to draw it forward.

"By dissection and experiment it can be proved, that the oblique muscles are antagonists to each other, and that they roll the eye in opposite directions, the superior oblique directing the pupil downward and outward, and the inferior oblique directing it upward and inward. But it is proved that any two of the recti muscles are equal to the direction of the pupil in the diagonal between them ; and there is no reason why an additional muscle should be given, to direct the pupil upward and inward more than upward and outward, or downward and inward. It is evident, then, that the oblique muscles are not for assisting the

recti in directing the eye to objects, but that they must have some other appropriate office. If we proceed farther, it must be by experiment.

“To these, other objections, no less strong, may be added. We have just found that certain very rapid motions are to be performed by the eye-ball : now it can be demonstrated, that a body will be moved in less time by a muscle which is oblique to the line of motion, than if it lay in the line on which the body moves. If the oblique muscles were either opponents or coadjutors of the recti, there appears no reason why they should be oblique, but the contrary ; for as the points of their insertion must move more rapidly than those of the recti, they are unsuitable. On the other hand, that there may be no difference in the time of the action and relaxation of the several classes, we see a reason why one rectus should be opposed by another, and why, there being occasion for one oblique, its antagonist should also be oblique.

“In proportion as a muscle gains velocity by its obliquity, it loses power ; from the obliquity, therefore, of these muscles believed to be opposed to the recti, and from there being two of them to four of the latter, they are disproportioned in strength, and the disproportion proves that the two classes of muscles are not antagonists.

“*Experimental Inquiry into the Action of these Muscles.*

“I. I divided the *superior rectus* or *attollens* in a rabbit, and felt something like disappointment on observ-

ing the eye remain stationary. Shortly afterwards, on looking to the animal while it was feeding, I saw the pupil depressed, and that the animal had no power of raising it.

“ The explanation I conceive to be this : during the experiment the eye was spasmodically fixed by the general action of the muscles, and particularly by the powerful retractor, a muscle peculiar to quadrupeds. But on the spasm relaxing, and when the eye was restored to the influence of the voluntary muscles, the recti, the voluntary power of raising the eye being lost by the division of the superior muscle, the eye was permanently depressed.

“ II. Wishing to ascertain if the oblique muscles contract to force the eye-ball laterally towards the nose, I put a fine thread round the tendon of the superior oblique muscle of a rabbit, and appended a glass bead to it of a weight to draw out the tendon a little. On touching the eye with a feather, I had the pleasure of seeing the bead drawn up. And, on repeating the experiment, the thread was forcibly drawn through my fingers.

“ By experiments made carefully in the dead body (having distended the eye-ball by dropping mercury into it to give it its full globular figure), I had found that the action of the superior oblique muscle is to turn the pupil downward and outward, and that the inferior oblique just reverses this motion of the eye. In the above experiment there is abundance of proof that the superior oblique muscle acted, and yet the pupil

was not turned downward and outward, therefore both oblique muscles must have been in action. Their combined action draws the eye-ball towards the nose.

“ In the violent spasmodic affection of the eye, when it is painfully irritated, I believe that all the muscles, both of the eye-ball and eye-lids, are excited. In quadrupeds, I have ascertained that the oblique muscles act when the haw is protruded ; but I have also found, that the retractor oculi alone is capable of forcing forward the haw.

“ But quadrupeds, having an additional apparatus of muscles to those of the human eye, are not suited for experiments intended to illustrate the motions of our eyes. The monkey has the same muscles of the eye with man.

“ III. I cut across the tendon of the superior oblique muscle of the right eye of a monkey. He was very little disturbed by this experiment, and turned round his eyes with his characteristic inquiring looks, as if nothing had happened to affect the eye.

“ IV. I divided the lower oblique muscle of the eye of a monkey. The eye was not, in any sensible manner, affected : the voluntary motions were perfect after the operation.

“ V. On holding open the eyes of the monkey, which had the superior oblique muscle of the right eye divided, and waving the hand before him, the right eye turned upward and inward, while the other eye had a scarcely perceptible motion in the same direction.

When the right eye was thus turned up, he seemed to have a difficulty in bringing it down again.

“From experiments, it is proved that the division of the oblique muscles does not in any degree affect the voluntary motions by which the eye is directed to objects.

“This cannot, however, be said of the involuntary winking motions of the eyes. We have seen that in winking to avoid injury, the oblique muscles were in operation; and that the inferior oblique muscle gained in the power of elevating the eye-ball by the division of the superior oblique, its opponent.

“These revolving motions, accompanying the winking motions of the eye-lids, are of the utmost consequence to the preservation of the organ. A case which was some time under my observation proved this. By a defect of motion, the eye and eye-lids remained fixed, and the consequence was that the cornea inflamed and became opaque. Another curious circumstance in this case was, that when the eye-lids were closed, the patient still saw red light through the affected eye, the reason of which was that the eye-ball did not turn up when the eye-lid was closed.

“If we close the eyes opposite to the window or before a candle, and continue to attend to the sensations of the eye, we shall still see red light coming through the eye-lids. But if we make an effort to close the eye-lids (though they be already shut), we shall be in momentary darkness, because during the effort the eye-balls are then turned up. Thus it appears that the

dropping of the eye-lid would make but an imperfect curtain before the eye, and the eye, to be entirely protected from the light, must have the pupil turned upward."

The following experiments by Mr. Duffin, of London, will be found in the main confirmatory of the preceding.

"**EXP. I. *Division of the Internal Rectus.***—The tendon of the adductor of the left eye, of a middle-sized, half-bred spaniel dog, was carefully separated from its attachment to the sclerotic. The pupil was instantly directed permanently towards the outer angle of the orbit, and to such an extent that, next day, fully one third of the cornea was concealed from view. The animal appeared to be wholly incapable of disengaging the pupil from this situation; nor did he acquire the power of doing so in the slightest degree afterwards.

"**EXP. II. *Division of the External Rectus of the same Eye.***—In the course of a week from the performance of the above operation, the *external* rectus of the same eye was divided, but without producing any sensible alteration in the position of the eye-ball; the pupil still continued to be everted, and partially concealed in the temporal angle of the orbit.

"From these facts we may conclude, either that the muscle had not time to form a reunion with the sclerotic coat, or that the eye-ball having been so long unremittingly turned outward, the reunion was estab-

lished too far posterior to the original insertion to enable the muscle to invert the pupil again.

“**EXP. III. *Division of the External Rectus Muscle alone.***—The abductor of the left eye of another dog, similar in size to the last, being carefully divided, the pupil was permanently turned inward towards the nasal canthus of the orbit, *but not in quite so great a degree, as in the first experiment it was turned outward.* Nor did the animal, in this instance, apparently possess any power to dislodge it from its unnatural situation. This we ascertained, in both experiments, by holding its head in a particular position, and then calling the attention of the animal to the opposite direction. On such occasions the intact eye alone obeyed the summons of the will ; the other did not move in unison with it.

“**EXP. IV. *Division of the Inferior Rectus.***—In this instance the tendon of the inferior rectus was separated with great care ; the animal lost completely all power of directing the pupil downward when that of the other eye was depressed ; but it was not drawn upward, as was expected, by the action of the superior rectus. Three days afterwards, however, it was found to be displaced in this direction, the upper third of the cornea being concealed under the superior palpebra, which situation it continued to occupy.

“**EXP. V. *Division of the Superior Rectus.***—The superior rectus of the left eye of a middle-sized dog was separated from its insertion ; the position of the

pupil was not altered, although it appeared that the animal could not direct the eye upward.

“**EXP. VI. *Division of the Inferior, Internal and Superior Recti.***—This experiment, as will be immediately shown, was performed for a special purpose. The inferior rectus was first detached, then the adductor, and finally the superior muscle. The pupil at first preserved its natural central position, but in the course of two days afterwards was found to be directed outward, and very slightly upward.

“My object in performing this experiment was to ascertain whether, when the internal rectus has been divided to remedy strabismus, and the pupil is drawn upward under the superior palpebra, in consequence of the deformity having arisen from *paralysis* of the *inferior* rectus, any benefit would be derived from dividing the superior muscle. From the result of the experiment, and the experience of two cases of this description which I have met with, it appears to me that the operation would be useful *after the adductor tendon has become reunited to the eye-ball.*

“**EXP. VII. *Division of all the Straight Muscles.***—In this experiment all the straight muscles were detached; the pupil remained fixed in the visual axis of the orbit. When irritated, the eye-ball was retracted, and the membrana nictitans was suddenly spread over the forepart of the eye at the same moment, so that it was quite impossible to decide what influence the oblique muscles exerted, or whether they produced any special movement at all. It was clear, however, that

they neither drew the eye towards the outer nor the inner angle of the orbit. Hence I am disposed to imagine, as already stated, that when both of these muscles contract together, they tend to steady the eye-ball in the visual axis of the orbit, and contribute to modify the focus of the eye by compressing the sphere. They are, in such case, opponents, though in a slight degree, of the external rectus.

“**EXP. VIII. *Division of the Superior Oblique and Internal Rectus Muscles.***—The greatest difficulty was experienced in performing this operation satisfactorily, in consequence of the retraction of the eye-ball, and the protrusion of the membrana nictitans. A sharp-pointed bistoury was introduced at a right angle to the tendon, and about midway between the trochlea affixed to the frontal bone, and the insertion of the muscle into the sclerotic. The instrument was pushed sufficiently deep into the orbit, to secure the cutting of the tendon on its being withdrawn with the point in contact with the roof of the orbit. ‘There could, therefore, be no doubt that the tendon was divided.’ No apparent change occurred in the position of the pupil; nor could we perceive that the movements of the eye-ball were in any way modified, or destroyed, by the operation.

“The insertion of the internal rectus of the same eye was next separated from the sclerotic, and instantly the eye-ball protruded *considerably*, and the pupil, dilated in a most extraordinary manner, was drawn diagonally outward and upward, as if by the equal co-

operation of the outer fibres of the superior rectus, and the upper fibres of the external, or abducens, muscle. The eye-ball afterwards retained this position, and when the muscles were sympathetically irritated to involuntary contraction, by gently touching the cornea, was always retracted by the action of the retrahens. On such occasions, the upper and outer portion of the sphere appeared to be the part most retracted; the lower and inner portion being, at the same moment, made to advance obliquely, and project in a remarkable manner.

“EXP. IX. *Division of the Internal Rectus and Superior Oblique Muscles.*—In the ninth experiment the foregoing operations were reversed on another dog: the section of the internal rectus was first performed, then that of the superior oblique muscle. The results were similar to those just related. The eye-ball was directed outward and upward; its anterior inferior surface was brought into view, and considerable protrusion took place, accompanied by remarkable dilatation of the pupil. When the internal rectus alone was divided in this experiment, as in No. 1, the pupil was turned directly outward; but, when the superior oblique was cut across, its direction was found to be outward and upward. This diagonal direction of the pupil, then, in the two last experiments, although such as might be presumed would be produced by the equal co-operation of the external and superior recti muscles, I am inclined to attribute, in a great measure, to the uncounteracted action of the inferior oblique, since it

was exactly what might have been anticipated from the direction of the fibres of this muscle, and did not become *diagonal* until the section of the superior oblique had been performed. Be this as it may, the other result, viz., great projection of the lower portion of the eye-ball, so that the anterior part of its under surface was brought into view on slightly depressing the lower eye-lid, could be attributed to no other cause than the contraction of this muscle when unopposed by the trochlear.

“EXPS. X. and XI. *Division of the Inferior Oblique and Internal Rectus Muscle.*—These experiments were conducted in a similar manner to the two last related, and the section of the former muscle, the inferior oblique, was accomplished on the same principle as had been that of the superior oblique; the bistoury being withdrawn with its point in contact with the floor of the orbit. The results which succeeded were very similar to those we had already witnessed. The eye-ball protruded as soon as the adductor was cut across, but not before; neither did it project in so great a degree as in the former experiments. The pupil was directed outward, but not upward; and in this situation it remained immovably fixed.

“Most of the foregoing experiments I have repeated several times, and uniformly with the same results; the degree in which they manifest themselves, however, being various in different animals.”

We may therefore conclude, that the four recti mus-

cles are principally, if not exclusively, concerned in the voluntary motion of the eye, by which its direction to objects is determined. Although the muscular apparatus of each eye is separated and distinct, we find that there exist certain uniform relations between the actions of the muscles of both. The contraction of the superior rectus of the right eye is accompanied simultaneously and necessarily by the contraction, to the same extent, of the superior rectus of the left; the contraction of the rectus externus of the right eye, by the contraction of the rectus internus of the left, &c. This sympathetic action of the adductor or rectus internus of one eye, with the abductor or rectus externus of the other, is in some measure explained by referring to the anatomical relations which the nerves supplying these muscles respectively bear to each other in their origin and progress from the brain. The sixth nerve, whose sole office is to supply the rectus externus, and the third pair, which is given to the rectus internus in common with two other muscles, both originate from the motor tract of the corpus pyramidale, and are separated only by the breadth of the pons varolii, besides which they subsequently "communicate very freely in the cavernous sinus by means of the carotid plexus, and indirectly through the medium of the ciliary ganglion, carotid plexus, and superior cervical ganglion of the sympathetic nerve." Thus the pupils of the two eyes are made to move in unison, directed to the same objects. If, however, the relations of the muscles become disturbed, there being in one or more muscles an

excessive or diminished contractility, the motions of the eyes do not correspond, one eye only can be directed to a given object, and in looking forward the pupil of but one is found in the centre of the orbit. It should be observed, that the visual centre of the orbit is somewhat within its actual centre, since in looking at one point the antero-posterior diameter of the eyes must converge slightly, the convergence being greater as the object is nearer.

Bell, Cruvelhier, &c.

STRABISMUS.

Strabismus, or squinting, is that condition of the eyes, in which, when an attempt is made to look at an object, one or both of them wander from the axis of vision, and both cannot at the same time be directed to the same point. Upon closing the sound eye, the other can ordinarily be moved with facility in every direction, and the deformity for a time is removed, to recur as soon as the sound eye is re-opened. In other cases, and they are very few, the distorted eye is immovably fixed, and on closing the other no alteration can be effected in its position. In view of this mobility and immobility, writers upon diseases of the eye have usually recognized in these cases two distinct diseases, classing those in which the motion of the eye can be controlled when the sound eye is shut, under the denomination of Strabismus; and those in which it cannot, under that of *Luscitas*. The difference in

these cases, however, seems to be rather in the degree than the nature of the complaint; for beside these cases of perfect ability and complete inability to move the eye, there are others in which the motion of the distorted eye is partially subject to the will. Where the pupil is inclined far to the inner canthus, it is very often found, that in using this eye independently of the sound one, the pupil cannot by any effort be turned nearer to the outer canthus than the centre of the orbit, or else that it can be brought out only so far as to render a small portion of the sclerotic visible between the cornea and the inner canthus. When the eye is inclined outward, also, it will sometimes be found that the power of moving it in the opposite direction is possessed but to a limited extent. There are indeed the same differences in this respect that there are in the amount of the squint in different cases. In some rare instances, moreover, all power of moving the eye in some one direction is lost, without any appearance of strabismus in the eye, the pupil remaining fixed in the centre of the orbit, or else following the sound eye in the opposite direction only. I shall therefore comprehend under the term strabismus, all cases in which there is a want of correspondence in the axes of the eyes. (See Cases VI. XIV. and XIX.)

The inclination of the eye may be inward (*strabismus convergens*), outward (*strabismus divergens*), upward (*strabismus sursum vergens*), or it may be intermediate between these, as, for instance, upward and inward, or upward and outward. Of these, the strabismus convergens is the most frequent.

Strabismus may affect one or both eyes at the same time, or alternately.

Causes.—The remote causes of strabismus are various. It may be developed in early infancy, and is also perhaps in some cases congenital.* In all children immediately after birth, great mobility is observed, and their movements are irregular and unsteady. The eyes participate in this general condition, and there is at that time a sort of natural strabismus, and dulness of look, like what is seen in amaurotic persons. At this time, it is very important that the eyes should be educated or trained to move in harmony, by showing to them attractive objects in a proper position and at suitable distances, or at least by removing from them any temptation to place the eyes in an unnatural or unusual position. It is possible, that from carelessness in this respect a permanent squint may be acquired. Strabismus has been supposed to have been caused by placing the cradle of the infant so that the light shone on one side, or so that some striking object was visible to one eye only. Strabismus divergens might result from placing the child between two equally interesting objects, for instance, its nurse on one side and the light on the other. Strabismus convergens may result from showing to him objects too near the eyes, or from a

* In two cases upon which I have operated, intelligent parents have been confident that the squint was as decided at birth as at any subsequent period.

wart or other blemish on the nose. An upward strabismus may be developed by laying the child with his head toward the light or any other object which strongly excites his attention.

Strabismus is sometimes, though rarely, in infancy, and perhaps also in adult life, sympathetic with a disease or irritation of some distant organ, as, for example, the cutting of teeth, or the presence of worms or scybalæ in the intestines.

The cerebral affections incident to childhood are a more frequent source of strabismus than is generally supposed; and many of those cases commencing in infancy, the cause of which is unknown, are really the effect of cerebral irritation, of which the strabismus was at the time the only obvious symptom. Strabismus is so common a symptom of various disorders, unquestionably originating from cerebral affections, as hydrocephalus, epilepsy, catalepsy, &c., that it is not irrational to conclude that it may be in some cases the sole indication of a slight degree of cerebral irritation.

Violent muscular effort, whether involuntary, as in hooping cough, or voluntary, as in hewing wood, has produced strabismus.

An interruption of the functions of the nerves supplying any of the muscles of the globe, from the pressure of a tumor, a blow, or otherwise, may also cause strabismus, which in this case will probably be accompanied with a falling of the upper lid. The mechanical pressure of a tumor in the orbit against the globe, may give it the resemblance of a squint, though usu-

ally not until it has so projected the globe as to render a mistake as to the cause of the strabismus impossible.

Bandaging a weak or diseased eye, and allowing the other to be used independently of it, is often, in early life, an occasion of squinting.

Attempts to imitate one who squints are said to result sometimes in strabismus.

Powerful irritation of the conjunctiva may cause a squint ; and Mackenzie mentions an instance in which the oily juice of an orange peel injected between the lids, caused a child to squint.

Opacities of the cornea may produce strabismus, provided they are so situated in front of the pupil, and of such size, as to permit the rays of light to pass in an oblique direction only. Hence it is, that strumous ophthalmia is so often followed by strabismus.

Cataract, amaurosis, &c. are also recognized as causes of strabismus, in early life.

An inequality of vision in the two eyes, either as regards the amount of vision or the focal distance, or both, is perhaps the most common cause of strabismus, the squinting eye being of course that in which the sight is least distinct, or the focal distance shortest. This inequality of vision is often congenital, and of course unavoidable. It is also often enhanced, if not produced, by the injudicious use of one eye to the neglect of the other, in certain habits and usages of refined life. In playing at billiards, shooting, looking through a telescope, &c. one eye is often shut to enable the other to make more correct observation ; and

by some persons, one eye alone is habitually employed in viewing distant objects through a single lens. The inequality of vision by which strabismus may be produced is estimated by Buffon at three eighths.

However various may be the remote causes of this affection, its immediate cause is a want of balance in the action of the muscles which have been described, especially the four straight or recti muscles. This may consist either in an excess of power in the muscle of the side toward which the eye is inclined, or in a diminution of the power of its antagonist muscle. In a large majority of cases, it is evident that the deformity is owing to an inordinate action of the muscle, first from the origin and history of the disease, showing it to be unconnected with any general or local causes of muscular debility ; secondly, from the painful feeling of tension experienced by the patient when the eye is turned in the opposite direction ; and, thirdly, from the increased volume, and, in some few cases, the indurated texture of the muscle, as shown by dissection.

That in some cases the squint has originated in a loss of power in the muscle on the opposite side of the eye to that in the direction of the squint, is probable, first, from the nature of the remote causes by which it was produced, as, for instance, an injury to the nerve supplying the muscle, or an evident paralysis of neighboring parts ; and, secondly, from the very slight immediate change of position, and very gradual restoration to the centre of the orbit, which takes place

in some rare cases after division of the muscle on the side of the squint. In the greater number of cases, without doubt, both these conditions are combined. The powerful contraction of the internal rectus, which is sufficient to overcome the healthy action of the external rectus muscle, will, by keeping it constantly extended, lessen in a degree its contractility; and, on the other hand, a partial loss of tone in the external rectus, allowing its antagonist to contract inordinately, may induce in the latter a shortening of its fibres and increase of its volume. This hypertrophy of the muscle is frequently apparent at the time of the operation, and is supposed by some European writers to be accompanied by an increased supply of blood and a deeper color. Although of course no direct comparison can be made of different muscles in the same individual, it is highly probable that there is an increased vascularity, from the abundant flow which sometimes follows the division of the muscle far back, and also from the fact that in some cases of strabismus, on everting the eye, the reddish hue of the anterior portion of the muscle is more clearly visible through the conjunctiva, than in the opposite sound eye.

In addition to the abnormal condition, above mentioned, of the muscle on the side of the squint, dissection also exhibits, in some cases, a similar condition of the adjacent *cellular tissue*, which may become to a considerable distance exceedingly thickened and unyielding, particularly where ophthalmia has preceded or accompanied the squint. This occasional partici-

pation of the cellular tissue in the disease it is of great practical importance to remember. (See Cases I. VIII. XII. and XIX.)

Prognosis.—If left to itself, the number of cases is exceedingly small in which a spontaneous restoration of the eye to a natural position takes place, and this is to be hoped for only where the disease is sympathetic with an affection of some distant organ, or when it depends upon a cause admitting of speedy removal, and especially only when it is of recent date. Though the muscle may not have been originally the seat of the affection, it very soon becomes habituated to its undue contraction, acquires by it an increased power, and perpetuates the distortion of the eye after the remote first cause of it has been removed by the efforts of nature or art.

Influence of Strabismus on Vision.—The immediate and most obvious effect of strabismus is to produce double vision, that is, to convey to the mind, for any one object, the image of two, and this because in one eye the image of the object is now formed upon a portion of the retina which has not been accustomed to convey impressions in unison with those formed upon the portion of the retina with which the object is seen in the other eye. This inconvenience gradually subsides as the person learns to neglect the sensations of one organ, or the mind perhaps ceases to refer the same image on different parts of the retina to different

objects. From the oblique direction in which the rays of light enter the pupil of the squinting eye, its vision is indistinct, and when the inversion is extreme, the eye may be considered useless in this respect. From the long continued disuse of the squinting eye, it becomes enfeebled, and this is invariably the case, in a greater or less degree, according to the amount and duration of the inversion.

I am, however, disposed to think that in some cases the strabismus of itself produces a species of amaurosis, wholly independent of the weakness of sight consequent upon long disuse. In several cases upon which I have operated, an instantaneous improvement of the vision of the eye which squinted has taken place, altogether inexplicable on the supposition that want of exercise alone had impaired its strength. I have been careful to ascertain, since my attention was attracted to this point, that the patient did not confound the general improvement of vision which might be expected to result from the bringing both eyes to bear upon the same object, with an increase of vision in the strabismic eye. In two cases this improvement was mentioned by the patient, with an expression of surprise, the moment the operation was completed, and before the bandage was removed from the sound eye; and in the others there was no reason to doubt their intelligence or veracity. From this sudden increase of vision, simultaneously with the division of the muscle, it is reasonable to infer that the access of the affection was marked by a considerable and rapid diminution of

it ; but as regards this, no information could be obtained, these cases having all originated in infancy or early childhood. I have as yet seen no notice taken of this phenomenon in any of the journals of the day, and know of no explanation of it, unless it be that the inordinate contraction of one muscle, antagonized by others not readily yielding to its force, exerts such a pressure upon the globe as to paralyze the retina or optic nerve. (See Cases IV. XVII. and XX.)

If both eyes are equally and at the same time inverted, in addition to the indistinctness and occasional confusion of vision necessarily resulting, the person is very short-sighted.

Treatment.—When there is ground for supposing that a remote cause of the deformity, independent of the unequal action of the muscles, is still in operation, the first indication is, of course, the removal of this cause, by the appropriate means, as, for example, a vermifuge when worms are present in the alimentary canal, lancing of the gums in difficult dentition, and discutient collyria when an opacity exists near the centre of the cornea. A boy, 9 years of age, about a year ago received a wound through the cornea of the left eye, causing a lenticular cataract, which soon left him a mere perception of light. In a few months a trifling obliquity was observed in this eye, and about eight weeks since I performed the usual operation of breaking up the lens. As vision was restored, the inversion, previously very slight, became less evident,

and has now wholly disappeared, although the cataract is not yet quite dissolved.

If, after the removal or subsidence of the remote cause, the strabismus continues, the treatment must be adapted to equalize the action of the muscles. For this purpose many contrivances have been suggested to increase, by bringing into exercise, the power of the muscle antagonizing the one in the direction of the squint. With infants, to effect a cure it is sometimes sufficient to hold frequently at a considerable distance, directly in front of them, some attractive object. In convergent strabismus, it is recommended to make the patient wear a large green shade, and at times to place on each side of the forehead something projecting far enough to be seen by the eye of the same side, and not far enough to be seen by the eye of the opposite side. In strabismus divergens, Weller recommends the use of a hollow paper cone, the base of which shall include both eyes, while its open apex is in front of the nose. Each eye may be covered with a segment of a hollow sphere, having a small aperture in that part of it toward which it is desirable to accustom the eye to turn; and this, together with spectacles darkened except in one spot, is applicable to all the varieties of strabismus. In divergent strabismus, a patch is also worn upon the nose, or some material projecting in front of the same organ.

When the squinting depends wholly, or in part, upon a variation in the focal distance, or the amount of vision of the eyes, it is usual to bandage the sound eye

for a few hours daily, accustoming the patient to rely upon this eye and to use it in looking at distant objects. The bandaging of the sound eye may gradually be prolonged, as the suffusion, irritation, and in some instances headache, accompanying the treatment at the outset, become less troublesome. Beer seems to have met with success in many instances by this method. A great objection to it, however, in some cases, is, that while the strabismic eye is gradually becoming straight, the sound eye is acquiring an inversion. Under the same circumstances it was also customary to put on the patient spectacles, having before the squinting or short-sighted eye a plane glass, and before the other a convex lens, or else before the squinting eye a concave lens, and before the other a plane glass.

None of these methods can be expected to benefit the complaint after it is confirmed, and it has therefore remained, until recently, with very few exceptions, incurable. To the new and very successful treatment now adopted, the remainder of this treatise will be devoted.

Beer, Mackenzie, Middlemore, Sanson, &c.

DIVISION OF THE MUSCLES OF THE GLOBE FOR STRABISMUS.

November 13th, 1839, Professor Dieffenbach, of Berlin, first performed the operation of dividing one of the muscles of the globe for the relief of squinting; Prof. Stromeyer, of Hanover, having previously suggested the application of the principle which he had

successfully adopted in the treatment of other deformities, to the muscles of the eye.

The possibility of removing this deformity by dividing the muscles of the globe, had, it seems, many years ago been publicly stated. Mr. White, of London, not himself a professional man, about twelve years ago made numerous experiments on the muscles of the eye in animals, and strenuously recommened to the attention of the profession the division of these muscles for the cure of strabismus. Still earlier, in the year 1812, a surgeon of this city, Dr. Ingalls, senior, mentioned to a member of a class to which he was then lecturing on anatomy, this division of one of the muscles of his eye as the appropriate means of relieving its obliquity. But although these gentlemen, and perhaps many others, deserve the credit of originality in its conception, the merit of introducing the operation unquestionably belongs to him who first demonstrated its practicability in the successful performance of it. The operation, as first proposed and still practised by Prof. Dieffenbach, is given in his own words, as follows.

“*Operation.*—That for strabismus convergens is here taken as the type. The operator always stands on the right side of the patient, whether he be operating on the right or on the left eye. The patient sits on a stool, and an assistant standing behind him draws up the upper eye-lid with a Pellier’s hook. A second assistant draws down the lower eye-lid with a double hook which is set in a handle, and of which the teeth are connected by a transverse piece. He kneels down before the patient so as not to be in the way.

“ The operator then puts a fine hook into the conjunctiva at the inner angle of the eye, just where it is passing from the palpebræ to the bulb, passes it superficially through it, and gives it to a third assistant who stands on the left side of the patient. The operator next passes a second hook in the same way through the conjunctiva, about a line and a half from the first. He and his assistant then both at the same time draw their hooks a little up, so as to raise a fold of the conjunctiva, and at the same time pull the bulb somewhat outward. The fold is then divided with a pair of curved eye-scissors ; and this cut usually at once exposes the tendon and the anterior part of the muscle. A couple of cuts with the scissors then expose the outer surface of the muscle ; a rather blunt hook is passed under its tendon, and the two sharp hooks that held the conjunctiva are now removed ; the eye is held completely in the power of the blunt hook, and is to be drawn by it from out the internal angle of the orbit. A flat probe is then pushed under the muscle ; and the loose connexion by cellular tissue between it and the eye is broken up. The division of the muscle is made by the scissors already mentioned, either, first, through the tendon in front of the hook ; or, second, behind the hook at the beginning of the muscular substance ; or, third, some lines deeper back.

“ When the tendon is divided nothing of it remains on the eye, and the muscle commonly retracts a line backward. When the muscle itself is divided at its anterior part or further back, its posterior portion retracts, and the anterior, which remains connected with

the bulb, turns forward like a loose flap, which according to circumstances, may be removed by the scissors or pushed back into the wound if it is thought desirable that it should unite again with the posterior portion.

“In practised hands the whole operation seldom lasts more than a minute ; and it is done almost without pain.”

During its progress on the Continent and in Great Britain, different operators have suggested various changes, and in some instances improvements, in the mode of performing the operation. They may, perhaps, be most conveniently treated of by considering the operation as consisting of three stages ; the first or preparatory one, in which the globe is rendered accessible to the operator, at the required point ; the second, in which the conjunctiva and its subjacent cellular tissue are divided ; and the third, in which the muscle or its tendon is severed ; and taking up in connection with each the different means that have been used to effect it, without attempting to say to whom the merit or demerit of the innovations justly belongs.

First, the sound eye, or that upon which it is not intended to operate, being bandaged, the lids of the other are to be separated, and it is exceedingly important that the upper lid should be held firmly against the orbit. This may be done either by the finger of an assistant, or by a speculum,* the latter being indis-

* A drawing of a new and very convenient speculum, invented by Mr. Thompson, of Nottingham, England, is given on the plate. It af-

pensable when the patient is a child, and especially when the globe is small or the lids unusually thick.

The globe must now be turned in the direction opposite to that in which the strabismus takes place, bringing the edge of the cornea within a line of the canthus, this step being of more importance in strabismus convergens than divergens. For this purpose, some operators rely upon the voluntary effort of the patient, while by others a double hook is inserted about a line from the cornea, in the transverse axis of the orbit, through the conjunctiva into the tunica albuginea, and drawn steadily by an assistant, to the required extent, taking care to make no more pressure on the globe than is necessary to keep the points of the hook engaged in the tunica albuginea. In cases where the patient cannot or will not sufficiently control the eye to admit of the insertion of this hook between the cornea and the canthus, toward which the eye inclines, the globe must be brought partly round by another hook inserted on the opposite side of the cornea, to be removed, of course, as soon as the first has obtained a hold. Some operators have recommended the abandonment of this double hook in all cases, relying upon the voluntary effort of the patient, and possibly, also, upon the slight influence which may be exerted over the motion of the globe by the fine hook with which the conjunctiva is raised preparatory to making a di-

fords a larger space to the operator, and complete control of the lid, with no more pain to the patient than arises from the finger of an assistant.

vision of it. In the large majority of cases the operation may certainly be performed without the double hook as conveniently to the operator, and of course with less suffering to the patient and less subsequent inflammation.

The hook here referred to has a straight handle and shaft terminating in two fine hooks, curved at about a right angle, penetrating to the depth of not more than a third of a line, and distant from each other at their points one line. When properly inserted and held, it produces a very slight indentation upon the globe. As a substitute for this hook, a surgeon in London has recommended a single one, the entering part of which is somewhat longer, but which penetrates to no greater depth than the other in consequence of the acuteness of the angle at which the hook is bent upon the shaft. This, he conceives, will give a firm hold upon the outer coats of the globe in the motion of drawing it outward or inward, without the necessity of making so much pressure upon it as in using the other.

The use of either of these hooks is very objectionable. First, because the pain of the operation is very materially enhanced by them ; and secondly, because, unless the points are kept by the assistant steadily engaged in the firmer textures, there is danger of dragging the conjunctiva from its loose connections with the albuginea and even the cornea. They are, moreover, with some very rare exceptions, in which the inversion is extreme and the power of eversion very slight, altogether unnecessary for the effectual per-

formance of the operation, unless the operator is in the habit of dividing the muscle by means of a grooved director and knife. In upwards of forty operations, I have used the double hook but three times, and in two of those, if they had occurred later in my practice, I believe it might have been dispensed with. (See Cases II. IV. VI.)

The second step of the operation is the division of the conjunctiva and subjacent cellular tissue, in order to expose the muscle. This may be accomplished by cutting directly upon the conjunctiva from without inward, with a small straight knife, or else by cutting with a small curved knife from within outward and upward, having previously raised the membrane by a forceps, or fine hook, the incision being about three lines distant from the cornea, about half an inch in length and at right angles with the course of the muscle, the hook or forceps being left attached to the segment of the incision farthest from the cornea, provided only one hook has been used to raise the conjunctiva; when two are used the incision being between them. A fine hook is preferable to the forceps for raising the conjunctiva, because it gives less uneasiness to the patient, and cannot loose its hold until it is intentionally removed. It is desirable to include in the first incision the cellular tissue beneath, which will otherwise require a separate dissection, and before this is accomplished may become so infiltrated with blood as to deceive one with the appearance of muscular texture. One operator abroad uses a common

cornea knife for this purpose. Scissors are by some used at this stage of the operation, to make the single incision in the conjunctiva, and by others to excise a portion of it, which last proceeding is objectionable, because it leaves a greater work of reparation to be performed, and is likely to be followed by troublesome granulations from the exposed surfaces beneath, and also because the external support of the globe is thereby weakened, it having been observed that where the operation is rudely executed and the integuments extensively separated, an undue prominence of the globe takes place, prejudicial to the appearance of the patient, unless the eye operated on happen to be smaller than the other, though with the utmost care this is sometimes unavoidable when the squint is extreme.

The small curved knife is probably the most convenient instrument, as it can be passed through the conjunctiva and cellular tissue, and at one sweep be brought out on the upper side of the incision, without interfering with the lid of the patient or the finger of the assistant, or unnecessarily dragging the conjunctiva from the globe.

Finally, the muscle being fairly brought to view by this section of the conjunctiva and cellular tissue, it remains only to divide it. This is best effected, according to some, by a curved and grooved director with a knife ; according to others, by a hook having a cutting concave edge ; and according to others, by a bent probe and scissors. The bent probe and scissors appear to me best adapted to this purpose, because

they enable the operator to dispense with the double hook. So soon as the bent probe is carried under the tendon, the eye can of course be everted by it to any extent, and the division with the scissors made on either side, and at any distance from it; while with the director and knife, it must be made where the director is passed, the eye being in the mean time everted by the double hook to enable the operator to select the place of division. There is, moreover, an advantage in the use of the bent probe and scissors, that the probe being passed from above downward, and the scissors from below upward, the muscle or tendon, between these antagonizing forces, is less likely to escape division by slipping away from the instruments. To the hook with the cutting concavity, there is, of course, the same objection as to the director and knife. For the common blunt probe, Mr. Duffin proposes the flat one represented in the second plate, but it has no essential advantages over the other. The double hook, if it has been used, may be removed as soon as the hook or director has been passed under the muscle.

It has been proposed in various ways to simplify the operation. Mr. Clay, of Manchester, Eng., uses but two instruments, viz. a forceps and a pair of probe pointed scissors. With the forceps a portion of conjunctiva is raised and excised just above the upper edge of the muscle, and through the opening thus made the probe pointed blade of the scissors is passed under the muscle, until it is seen protruding through the con-

junctiva below when the blades are closed, and the muscle and conjunctiva divided together. It is, however, frequently desirable that the conjunctiva should be separated from the muscle previous to its division and consequent retraction, and Mr. C. speaks of the appearance of a small button of granulation as an invariable product of the wound, whereas this but seldom occurs in the usual mode.

A still further simplification has been practised by Mons. Guerin and others, viz., entering a small curved knife through the conjunctiva, carrying it beneath the muscle, and bringing it out through the conjunctiva, the division of all the textures is made at once. To this method the same objection applies as to the last, with the additional one that the integrity of the organ is endangered, it having sometimes happened that the point of the knife has been carried through the sclerotic as well as under the muscle, and the contents of the globe evacuated. Moreover, while in one respect the operation is simplified, in another it is rendered more painful, since it is indispensable to fix the eye with the double hook before the knife is introduced. It should be observed that the knife designed for this mode of operating is directed to be sharp enough at its point to pass through the conjunctiva, and *not* sharp enough to pass through the sclerotic.

The operation which was suggested and first performed by Mr. Bennett Lucas, of London, and which has been adopted by several intelligent operators abroad, seems to combine, as far as practicable, the advan-

tages of simplicity and thoroughness of execution, and is as follows.

A portion of conjunctiva near the inner canthus is raised upon a fine hook, and at one incision with the curved knife the conjunctiva and cellular tissue are divided. A bent probe is next carried under the tendon, by which the motion of the globe is perfectly controlled, so that the muscle or tendon may be divided with slightly curved scissors wherever the operator thinks best. If the division of the muscle is to be posterior to the incision of the conjunctiva, it is best to retain the fine hook in the conjunctiva on the inner side of the incision, in order to prevent including a portion of it in the division of the muscle; otherwise it may be immediately removed. If the globe be remarkably small and difficult of access (see Case XX.), scissors will be found more convenient to make the incision of the conjunctiva with. One assistant only is needed, though it is convenient to have two.

The operation has been performed by me in this manner in every case with the exception of three, an account of which will be given among the earliest cases at the close of this treatise, and its results have certainly exceeded my most sanguine expectations, both as regards the comfort of the patient and the ultimate result. Three instruments only are needed: a fine hook, bent probe and scissors.

There are two points upon which the success of the operation very much depends, which are of much

greater moment than the mere selection of instruments, and demand a careful consideration.

First, the place at which division of the muscle should be made. If too near the insertion of the tendon, the present squint will be but partially relieved; if too far from it, a squint in the opposite direction may ensue. In general, the less the squint, the shorter its duration, and the younger the patient, the nearer it should be to the insertion of the tendon; and, on the other hand, the greater the squint, the longer its duration, and the older the patient, the farther back it should be. In the first plate, the extreme points at which the division may require to be made, are indicated on the rectus externus muscle.

Second, thickened indurated cellular tissue in some cases requires to be divided in addition to the muscle, a very slight adhesion of cellular tissue or a few undivided fibres of expanded tendon being sufficient to defeat the intentions of the operator, and the only proof that the division of them has been complete is seeing distinctly the sclerotic coat beneath, except indeed where you feel from the yielding of the globe to the force with which you evert it that it is fully liberated. The most satisfactory evidence that the operation has been successfully performed, is a total inability to turn the eye toward the inner canthus; and although in many cases whose result is successful the power of inverting the eye was not much lessened, I have found in general those ultimately most perfect in which, for a day or two after the division, the eye was a little everted, the

reunion of the retracted muscle to the globe restoring in some degree its influence and bringing the pupil back to the visual centre of the orbit.

That a reunion of the muscle does take place, is probable from the fact, that in the course of the second week after the operation, the patient regains the power of turning the eye inward, and also, as Mr. Guthrie assures us, from observations which he has made where a second division of the same muscle became necessary, in which cases he has found the muscle attached to the globe some lines posterior to its natural insertion. Upon this point I have copied from a late number of the London Medical Gazette, the following account of the post-mortem examination of the eye of a man who was operated on Dec. 1st, 1840, and died at St. George's Hospital January 1st, 1841. "The external rectus had been completely divided just at the part where it was beginning to be tendinous; the muscle itself had retracted to the distance of about three quarters of an inch from its natural attachment, but still remained connected with the globe by a strong band of cellular tissue. This band was about three lines in width and about six lines in length, and was attached to the ball of the eye about two lines behind the original insertion of that muscle, and such was its strength that it allowed of being pretty forcibly pulled upon without giving way." The above is the only autopsy as yet reported in these cases.

Participation of other Muscles in the Strabismus.
—Sometimes, notwithstanding the complete division of

the internal rectus and separation of all adhesions of cellular tissue, the squint is at first but partially relieved. This may depend upon an undue contraction of the inner fibres of the superior and inferior rectus, and also, I believe, upon an undue contraction of the superior oblique. (See Case IV.) For although, in a state of health, the province of the oblique muscles may be simply to preside over the involuntary motions of the globe, and though they may never be concerned in the original production of the deformity, it is easy to conceive that from a long continued inversion of the globe their fibres may become shortened and contribute to the maintenance of the obliquity. Great caution should be used in the division of the whole or a portion of the fibres of these muscles, for, as we have seen from the experiments of Mr. Duffin on animals, it may be followed by a projection of the globe, an event which would be most likely to occur where the division was least needed. Although no rule can be given upon this point applicable to all cases, the following may perhaps be an approximation to one. If the remaining obliquity is slight, or the patient young, or the strabismus of recent origin, or, lastly, if the other eye be inverted also, though in ever so slight a degree, be satisfied with the division of the internal rectus, and a gradual amendment of the obliquity will take place as the abductor muscle recovers tone. But if the inversion be still considerable, if the patient be old, the squint of long standing, and the other eye perfectly straight, a division of one or a por-

tion of one of the other muscles is expedient. (See Cases IV. XII. and XIX.)

After treatment.—Both eyes may be closed immediately after the operation, and a linen compress dipped in cold water frequently applied to that which has been operated on. In about twenty-four hours the bandage should be removed from this eye, in order that it may be used independently of the other which is still closed, for the purpose of insuring the union of the muscle sufficiently far back. If after the operation the eye is not in the least everted, or if it is slightly inverted, the same end may be further promoted by placing a patch upon the wall in such a position as to compel the patient to evert the eye as far as possible to see it. If immediately after the operation the eye is considerably everted, both eyes should be left open, as it will be found that the eversion is invariably less when the other is open and directed straight forward or everted. In this case, also, the fixing the eyes upon a patch on the wall may be resorted to with advantage, the patch being of course on the side of the eye not operated on. In some cases where there is a less degree of eversion of the eye operated on, and at the same time a slight inversion of the other, it is serviceable to close the first, and leaving the other open to evert it as far as possible. This exercise of the eye is fatiguing, and its duration at first must be graduated by the feelings of the patient as well as the necessities of the case. It conduces in some cases very much to a perfect result, and should not be discontinu-

ed earlier than the twelfth day after the operation, at which time it is presumed that reunion has fully taken place. For a still longer period in convergent strabismus, the patient should refrain from using the eyes upon near objects. One of my earliest cases (see Case II.) was, I think, less benefited in consequence of my being unaware of the importance of this after treatment, and allowing her to apply herself too soon to sewing.

In some cases, though I have very rarely seen it of late, a fungous growth arises from the wound. This is directed by most operators to be touched with nitrate of silver or excised. The nitrate of silver, however, does not sensibly diminish the growth, and if you cut it off one day it sprouts up the next. It is best to leave it to itself, until the gradual reunion of the edges of the conjunctiva causes such an absorption of its base, that it is left attached by a mere pedicle, and may be snipped off without fear of reproduction. This may ordinarily be done about the 6th day from its appearance, provided it is not interfered with before.

Should the operation for convergent strabismus be followed by a divergent strabismus, if it is considerable the external rectus must be divided; and if it is slight, excising a portion of conjunctiva from the inner canthus will adjust it. This, however, is a very rare occurrence according to foreign operators, and must depend on making the division of the muscle too far back. I have met with but one instance of it, and this so slight that I believe the snipping of the conjunctiva only will be required. (See Case III.)

Why does not the division of one of the recti muscles for strabismus, always result in a turning of the eye in the opposite direction? Mr. Duffin, of London, who has had large experience as an operator for strabismus, and who writes upon the subject with great candor as well as ingenuity, says, "The most simple and natural reply to this query seems to be the fact, that in a state of health voluntary muscles have no disposition to contract, unless called into action by an effort of the will; and that when the eye is restored to the position it ought to occupy, the abductor muscle, being then completely relaxed, will not draw it unduly outward, unless that effort of the will be exerted. When, however, it does act in this untoward manner, we may argue that having been long accustomed to exert its influence against a morbidly-contracted antagonist, and other sources of opposition, it may have acquired more than natural powers of contraction; but these cease in the course of a short time, being lost either from want of practice or from being met by an equivalent degree of resistance, when a new union takes place between the divided tendon and the eye-ball." This explanation is unsatisfactory, for, in the first place, the antagonist muscle having been for a long period exposed to an unnatural tension, cannot be said to be in a healthy condition; and, in the second place, experiments on different animals have shown that the division of one of the recti muscles of a sound eye is followed by a strabismus of the eye in the opposite direction. It seems to me that the true cause

why the eye is not permanently everted, is that the antagonist muscle has become elongated and enfeebled, and that before it has recovered sufficient tone to evert the eye the divided muscle has formed a new attachment to the globe, and the balance is restored; and also that the divided muscle still continues to exert a slight influence on the motions of the globe by means of adhesions of cellular tissue far back in its fleshy portion, which it would be neither convenient nor desirable to separate. The inner fibres of the superior and inferior recti muscles, and perhaps, also, the joint action of the superior and inferior oblique, may exert some agency in retaining the pupil in the centre of the orbit when no voluntary effort is made to evert it.

Double Strabismus.—In some cases the strabismus is equal in both eyes, in others it affects one eye so little as to be manifest only on very minute inspection, and more commonly it is obvious in both, but more decided in one than the other.

When both eyes are turned, but not in the same degree, the operation is of course to be performed first on the eye which is most inverted, giving the patient to understand that the other eye also may require to be operated on, as the inversion of this is likely to be more observable after the other has become straight. The reverse of this, however, frequently occurs, the slight obliquity of the best eye gradually diminishing, and this even in cases of long duration, where it might be supposed that a contraction of the internal rectus, at

first merely sympathetic with that of the other eye, had from long continuance become permanent. (See Cases X. XIV. and XXV.) When there is in one eye a strabismus so slight as not to be perceptible, it may, after the other eye is straight, become apparent, and it is therefore desirable, at least for the satisfaction of the patient, to ascertain if the squint is actually double or not—that is to say, whether the operation will be required on one or both eyes. On this question, Mr. Hall, of Manchester, England, proposes the following test.

“If a person with convergent strabismus is directed to look straight forward at an object, about three yards distant, if one eye has the true visual axis, being perfectly straight, as long as the attention is directed to the same object, and capable of being freely moved to the full extent in every direction, whilst the other eye is inverted, the strabismus is single. If, however, both corneæ are inverted under the above circumstances, although the inversion of one eye may be so much slighter than that of the other as generally to have escaped observation, the strabismus is double. In this case, when one eye is closed, the other is perfectly straight; but when both are open, and the object of vision *not so near as to require convergence of unaffected eyes*, the inversion, however unequally, affects both.”

Mr. Bennett Lucas makes his diagnosis in the following manner. “Place the hand obliquely over the eye in such a manner as to hide all objects in front of

it, but kept sufficiently raised at the temporal margin of the orbit to enable us to watch its movements. The patient is directed to exercise the eye which is uncovered ; and if, at the time that he brings it to the centre of the orbit, the covered eye retreats into the inner canthus, the case is one of double strabismus, and both eyes will require to be operated on ; but if both eyes are at this period straight, or even if the covered eye has but a slight inclination inward, the case is one of single convergent strabismus, and the inner rectus muscle of one eye only will require to be divided."

I am accustomed to form my opinion by placing the patient at a short distance before me, directing him to close the doubtful eye, fix the squinting one on me, and presently, keeping the squinting eye if possible still in the same position, to open the other. If now the eye which has been shut is readily directed to me, and the squint temporarily removed ; or if this eye immediately becomes straight at the expense of the inversion of the other ; or if it be found, that when closed, it was not inverted, I conclude that but one eye will need to be operated on. But if the closed eye has become far inverted and does not readily become straight, both eyes may need to be operated on.

These tests, however, and all others with which I am acquainted, with the exception of the division of the internal rectus of the obviously squinting eye, are fallacious. Adopting either of them, the conclusion would be that in a large majority of cases both eyes were strabismic and required to be operated on, where-

as, in fact, the division of the muscle on the second eye requires to be performed in not more than one case out of seven. Still, in investigating a case of this sort, these methods are by no means valueless, for though by means of them it cannot be said that an operation will certainly be needed on the second eye, it may be predicted with confidence that it will not. In these cases a temporary inversion of the sound eye not unfrequently follows the operation on the squinting eye, and disappears in the course of twenty-four hours.

There are cases in which it is exceedingly difficult to say, not whether one or both eyes are strabismic, but which is the most so. I have sometimes found it impossible, from a protracted examination in every position, to decide upon which eye to operate first, and been obliged to leave the choice to the patient or his friends. Even in these cases, the division of the internal rectus muscle of the eye first operated on may be followed by the rectification of both, and the inversion of one eye proved to be only sympathetic with that of the other. (See Cases VII. XX. and XXI.)

The period that should be allowed to elapse between the operations on the two eyes must be measured by the peculiar circumstances of each individual case. As a general rule, the second eye should not be operated on earlier than the fourteenth day, and if in the mean time any improvement is discoverable, a further delay will be expedient.

Whenever an operation is practised on the second

eye, care should be taken either to make the division of the muscle very near to its insertion, or else to leave undivided portions of cellular tissue sufficient to control in some degree the position of the globe. One case has been alluded to, by a foreign operator, of divergent strabismus of both eyes, consequent on a neglect of this precaution.

Much diversity of opinion exists among writers, both before and since the introduction of this operation, as to whether strabismus may originally affect both eyes or not ; and as the disease at its outset rarely falls under professional observation, it is likely to continue a matter of speculation. It is sufficient for us, practically, to know that it does in some cases ultimately affect both.

Double operation—by which is meant the division of the internal rectus muscle of both eyes for the removal of a strabismus which affects one only. It has before been mentioned that in a few cases, notwithstanding the complete division of the muscle and separation of all adhesions of cellular tissue, and the absence of all proof that the other eye is implicated in the squint, the inversion is at first but partially removed, and that a subsequent improvement may be expected. This subsequent improvement may not take place, or after a certain progress may cease, leaving still an obliquity of the eye operated on, the other eye continuing, as before, straight. The remaining obliquity will be removed by dividing the internal rectus muscle of the sound eye, and the restoration of the in-

inverted eye will be as instantaneous as it ordinarily is from the division of the adductor muscle of the squinting eye. To the credit of originating this double operation, two gentlemen—Mr. Duffin of London, and Mr. Elliot of Carlisle—lay claim, and both undoubtedly with justice, although the date of Mr. Duffin's first case is somewhat earlier than that of Mr. Elliot's. No one, indeed, can operate long in these cases without remarking, that when, in double strabismus, after the internal rectus of the worst eye has been divided, an obliquity still remains in this eye, together with the original obliquity of the other, the division of the corresponding muscle of the second eye places both in the centre of the orbit ; from which the inference is very natural, that the same muscle of an apparently sound eye may have an influence on the morbid position of its fellow. I had, in fact, determined to try this plan in one case, before I had received any intimation of the practice elsewhere. Several attempts have been made to give the rationale of this singular effect, but as they are remarkable rather for ingenuity than soundness, and as the reasoning may for all practicable purposes be very conveniently summed up in one word, *sympathy*, I shall, to avoid the still further extension of what has already exceeded its intended limits, pass them over.

One of the two surgeons who first adopted this proceeding, is in the habit of making the division of the adductor of the sound eye simultaneously with that of the squinting eye, whenever this latter is not at once

rendered straight. Mr. Duffin prefers to wait awhile, and as it seems to me very judiciously, inasmuch as no harm can result from the delay, and it will be found in many cases to be all that is necessary to insure a perfectly satisfactory result. The operation on the sound eye should certainly be deferred until the third week after the operation on the distorted eye, and still later, provided any spontaneous amendment can be detected, however slow. (See Cases VIII. XV.)

Is the improvement consequent upon the operation immediate or gradual? M. Guerin, of Paris, speaking of four cases on which he had operated, says, "the results have been advantageous, but not immediately so. In one case only did the eye become quite straight soon after the operation; in the others there was merely an amelioration." The weight of authority, however, is altogether the reverse of this statement, most operators reporting, that the eye becomes immediately straight, or even inclined to the opposite side. As far as my experience goes, the success is instantaneous in the large majority of cases, and no subsequent improvement is to be expected, except as regards the motion of the eye, and a gradual restoration to the true axis, where the division has been followed by an inclination to the opposite side. The exceptional cases to this remark have already been discussed, and are in very small proportion to the whole number.

Results.—Although it may truly be said, that no operation in surgery is so uniformly successful, the

benefits of it have probably been, as is the case with all other novelties, somewhat exaggerated. A report, for instance, of two hundred and fifty cases, all successful, is hardly credible, if by success is meant, that in all these cases the eyes are, in their contour, direction and motion perfectly symmetrical. Still, though the results are various, giving in some cases more and in others less change from the original position than could be desired, the simple division of the adductor muscle of one eye is in a very large majority of cases sufficient to remove the squint entirely, and in others so essentially improves it, that it is observable only in certain positions.

With regard to the permanence of the cure by this mode of treatment, no reasonable doubt can now be entertained. It is hardly possible that a recurrence of the remote causes, which is in adult life an exceedingly unlikely event, should produce the same effect as before; for in most cases it may be presumed, that immediately after the division, if not before, the muscle attains nearly the utmost contraction of which it is capable, and the distance from its origin to its insertion being less, the same increase of morbid action as before could not, to the same extent, change the position of the globe. In my earliest cases, which were operated on not quite six months ago, no tendency to relapse has been exhibited, but, on the contrary, in some of them a more complete assimilation of the motions of the eyes has taken place in the course of this time. Sixteen months have elapsed since Profes-

sor Dieffenbach first operated in Europe, and in a report of his cases no allusion is made to a return of the complaint in any instance.

Effects of the Operation upon Vision.—For several days, and in some instances, occasionally, for several weeks, after the eye is brought to its true axis, things appear to the patient double, and in a few cases still further multiplied, while at the same time they are not unfrequently distorted, by an enlargement of their horizontal dimensions, just as if seen through an uneven pane of window glass. I remember but one adult patient, where the sight of the squinting eye was not materially impaired, in whom this phenomenon did not occur, and in her the squint was of so recent date, that the double vision produced by it had not yet ceased when the operation was performed and relieved her of this annoyance and of the strabismus at the same time. (See Case XVIII.) By degrees the false image is less frequent, becomes indistinct, or the two approach nearer to each other, until in the course ordinarily of a month the double vision is lost.

The squinting eye is sometimes exceedingly deficient in vision, or it may be has only a perception of light, and unless this imperfection has preceded and caused the strabismus, the division of the muscle may be followed by a very extraordinary and sudden renewal of vision. (See Case XVII.) In such cases there is probably, as has before been hinted at, a species of amaurosis analogous to that which is produced by a blow upon the organ, or the pressure of a tumor upon

the course of the optic nerve, and the instant improvement of sight following the division of the muscle is owing to the relief from the pressure exerted by its inordinate contraction. The disuse of the squinting eye being in all cases one cause, and in most cases the sole cause, of its inferior vision, which, as far as I have observed, is universal, there is accordingly, in nearly all cases, a slow but steady improvement of vision for a considerable period after the organ has resumed the exercise of its natural functions. But whether the amount of vision of the squinting eye itself is increased or not, the sum total of vision is always greater from bringing both eyes to bear upon the same object, except where there is an original difference in the focal distances of the eyes. The patient, moreover, is enabled to use the eyes for a longer time without fatigue, and to apply them with greater facility to reading, sewing, &c. The short-sightedness of double strabismus is of course immediately relieved. Upon the whole, an amendment of vision may be considered an almost invariable consequence of the operation, which derives from this circumstance a much higher degree of importance than it can claim as the means of removing a deformity merely.

Selection of Cases.—Although this operation is one of very general applicability, an indiscriminate performance of it is much to be deprecated, and it may not be useless to mention here certain cases in which it is inexpedient, because the fewer their number, the

more likely they are not to be appreciated by a zealous operator.

All cases should be excepted in which the remote or first cause of the strabismus is still, or has recently been, in action—as, for example, where one side of the globe is projected by a tumor within the socket, or the patient is subject to chorea, epilepsy, or other nervous affections.

When there is reason to apprehend complete paralysis of some or all of the recti muscles, as may be indicated by distortion of other features of the face, or immobility of the eye at the same time that the strabismus is not extreme, division of the muscles would be inexpedient.

If the squint seldom occurs, and is seen only during bodily or mental excitement or fatigue, the position of the eye being in the intervals normal, a division of the muscle would not be proper.

When, instead of a want of correspondence in the axes of the two eyes, there is a disposition in both to look far to the right or left, it will probably be found that the trouble is referable to another cause than a want of balance in the muscular apparatus, of which the following case is an example. C. S., æt. 11, of Boston, had at birth an uncommonly large head, but exhibited no other marks of cerebral disorder. The head has not grown proportionably with the rest of the body, and now measures two feet one inch in its greatest circumference. Health and intellect good. The axes of the eyes are parallel, but both disposed to turn

toward the right, so that there is an almost constant inversion of the left and eversion of the right eye. Vision of the left eye is less distinct than of the right, but in neither perfect, and continued application causes pain, especially when an effort is made to bring them into the centre of the orbit, which can be done only for a few seconds at a time. This obliquity of the eyes is doubtless dependent on an organic lesion of the encephalon, and I declined operating for it.

Strabismus is sometimes complicated with nystagmus bulbi; and if the squint is extreme and the tremulous motion of the globe chiefly observable when an effort is made to evert the eye in opposition to the powerful contraction of the adductor, it should be divided. (See Case XXIV.) If the nystagmus is the predominating symptom, the obliquity being slight, the operation is inexpedient; though if the squint is considerable, it may be done, with the understanding, on the part of the patient, that, though the obliquity should be removed, the vibratory motion may still remain.

A perfectly sound eye may be suspected of a squint, as is the case with Mr. H——, who has no power of turning the left eye outward, although it is in the centre of the orbit when the eyes are at rest or looking forward, and is turned inward only in correspondence with the outward movement of the right. Consequently, in looking at an object on the left, the left eye is in the centre of the orbit, while the right is turned toward the inner canthus and apparently squints.

Youth is not in itself an objection, provided the remote cause has passed away, and sufficient time has elapsed to preclude the hope of relief by other means ; and advanced age offers no bar to an operation, the pain of which is too trifling to be regarded, and which is successful at all ages.

APPENDIX OF CASES.

I HAVE selected from my recent cases those which presented points of peculiar interest, or were best adapted to illustrate the preceding observations, and have given all of the earlier ones, because they show the most conclusive evidence of the permanence of the cure, and also because some of them afford an opportunity of pointing out errors, by guarding against which, the success of the operation and the comfort of the patient may be materially promoted. I refer particularly to the three, in which alone the double hook was used, which it will be seen were attended with more inflammation and were longer in becoming sound than any others. I have been careful to ascertain with accuracy the condition of all of them at the present time, particularly as regards improvement of vision. The operation in all of them is the same as that described in 46th page, except when in the description of the case some deviation is mentioned.

I. *Division of Internal Rectus of both Eyes.*—Sept. 9th, 1840. Miss S. H. æt. 18, of Boston, squinted at birth with both eyes, much as at present. Now the left eye is very much inverted, so that when she

looks forward with the right, the pupil of the left lies at the inner canthus. If both eyes are closed for a minute or two and the left opened alone, it can be moved in any direction, and if it be directed straight forward and the right then opened, the right will be found inverted nearly as much as the left ordinarily is. The turning out of the left eye causes pain at the inner canthus. Vision of this eye is much impaired. Using it alone she cannot see to read, and it very soon becomes fatigued. Drs. Davenport and Gray being present, the internal rectus of the left eye is divided. No change in the condition of the eye, except that she can turn it more freely outward. Cold lotion to left eye, both to be covered.

Oct. 17th. A slight improvement of the squint perceptible; vision improved. At my request, with the assistance of Mr. Stone, a second division of the muscle is made farther from the insertion. The left eye became immediately straight, and the right inverted somewhat. Right eye to be covered, and left turned out.

Oct. 22d. Left eye perfectly straight, and she has control of its motions in every respect, except that she cannot turn it quite so far to the inner canthus as the right. Miss H. having expressed a wish to try the effect of the operation on the right eye, the internal rectus of this eye was divided, in the presence of Drs. S. Keep, Dyer, Dale and Salisbury, with an immediate amendment. Left eye to be covered, right turned out.

March 24th, 1841. This is the only case in which

I have found it necessary to repeat the operation, and the repetition in this case was owing to my being unaware of the agency which the cellular tissue has, in some cases, in maintaining the obliquity, and perhaps, also, to making the division in the tendon rather than the muscular portion at the first operation. Now, both eyes are perfectly straight, and their movements in every direction harmonious. She can now see with the left eye to read with ease, and thinks the vision of this eye as good as that of the right; while in the joint use of the two, she finds herself able to read and sew with much greater facility and exactness than formerly.

II. *Division of Internal Rectus*.—Oct. 16th, 1840. Miss Mary M. C., æt. 23, of Boston, has squinted from birth with both eyes, the left being more decidedly turned in, the edge of the cornea of which frequently reaches the inner canthus. She can, on closing the right, turn the left out nearly as far as the other, but cannot keep it fixed there. Vision has always been weak, and she is conscious that this eye does not assist in seeing.

Drs. Reynolds, Jeffries, Hooper, Bethune and Charles Ware, were present. The eyes being small and the patient very timid, I found it necessary to control the globe by fixing a double hook through the conjunctiva into the tunica albuginea about a line and a half from the edge of the cornea towards the inner canthus. By this means the eye being fairly everted, the muscle was divided just behind the tendon, prefer-

able to a division of the tendon. On opening both eyes after the trifling hemorrhage had ceased, the left eye is observed to be straight, the squint of the right being as before. Apply compress wet with cold water. Keep both eyes covered.

17th. No pain, but complains that the eye feels heavy. Bandage removed.

22d. There is a considerable fungous growth from the place of the incision, which is cut off with scissors.

30th. Miss C. has been working at her trade as a tailoress for several days past, and says that after the day's work she finds the eye somewhat turned in. In the morning it is straight. The fungous growth has re-appeared, and requires to be touched with *nitras argenti*.

Nov. 18th. Since the last date, Miss C. has been obliged to apply herself sedulously to sewing, and the eye is turned in somewhat, a little more perhaps than the right, with which, as was at first stated, she squints a little. Still the eye is by no means so much turned in as before the operation; she has the privilege, as she terms it, of turning it out when she pleases, and finds it serviceable to vision, until it is fatigued by long use. She proposes to have the muscle re-divided when she has an opportunity of resting the eye for a time. The fungous growth has at length disappeared, and the redness at the inner canthus has diminished.

March 24th, 1841. A considerable improvement has taken place in the position of the left eye, which

is now but little inverted, and instead of repeating the division of the adductor in this eye, I now propose to divide the adductor of the right, with the confident expectation of thus overcoming the remaining obliquity of both.

III. *Division of Internal Rectus*.—Oct. 16th. Mrs. I., æt. 26, of Boston, squinted with the right eye at nine months of age, immediately after hooping cough. The squint is very decided, a portion of the cornea being hidden at the inner canthus. Drs. Doane, Dale and Parkman being present, the muscle was divided about two lines posterior to the tendon. On removing the instruments the eye was found to be perfectly straight, and capable of turning inward very little. Compress wet with cold water to be constantly kept on the eye, both being covered at the same time. Light diet.

18th. Mrs. I. suffering no pain, and having had none except for about 18 hours after the operation, and then not severe, I directed the eyes to be uncovered.

20th. Has had some pain, about as much as immediately after the operation, which may perhaps be attributed to her getting chilled by exposure to the night air while looking from the window at a fire. Renew application of cold water. Sulph. magnesia $\frac{3}{4}$ i.

21st. Eye comfortable. At several times since the operation she has had double vision for an hour at a time, but she has not observed it for three days past. Vision is much clearer and stronger than before the operation, and the only difference perceptible in the

eyes, which are both perfectly straight, is that the right cannot be turned to the inner canthus quite so far as the left.

Nov. 22d. Eyes perfectly straight and motions of both parallel, the right having a farther movement inward than immediately after the operation.

Jan. 12th, 1841. A slight eversion of the right eye perceptible, and a small fold of conjunctiva snipped off near the inner canthus, with the view of correcting it.

March 24th. No perceptible eversion. Both eyes straight.

IV. *Division of the Internal Rectus and Superior Oblique*.—Oct. 23, 1840. Wm. Augustus S., æt. 18, of Salem, when 4 years of age had an inflammation of the right eye, during which the eye was for a long time kept bandaged, and acquired a strabismus convergens. Now the eye is so far turned inward as ordinarily to conceal not only the pupil, but nearly the whole of the cornea, it being in short the most decided inversion I have ever seen. Vision with this eye is exceedingly indistinct, patient affirming, at first, that it was blind. On further investigation, it seems that he can just discern the outlines of large objects with this eye, at the distance of six feet. The loss of vision is partly to be accounted for by a slight opacity on the upper part of the cornea, but probably depends much more on the entire disuse of the eye for fourteen years. He can, by an effort of the will, turn it out nearly in front, but cannot retain it there more than

a few seconds. It was therefore necessary to evert it by means of the double hook. Drs. Channing, Putnam, Morrill and Hooper, and Dr. Gustine of New Orleans, were present. The eye was found to be considerably less turned, but still not straight, the squint being perhaps diminished one half. With the approbation of the gentlemen present, I then proposed the division of the superior oblique muscle, to which the patient assented. This was easily accomplished, without enlarging the incision or using the double hook, the eye being now sufficiently everted by the voluntary effort of the patient to bring the incision fairly in view. Passing the blunt hook under the conjunctiva at the upper extremity of the incision, it was readily brought round the tendon of the superior oblique, bringing it fairly into view, so as to be divided with the scissors. The eye immediately inclined slightly outward. He has still the power of turning it a little inward, and says that the vision of this eye has become more distinct. A compress wet with cold water on the right eye ; both eyes to be kept shut.

Oct. 27th. Has had no inflammation beyond the limits of the incision, which seems to be occupied by one large, smooth granulation, not sufficiently prominent to give him uneasiness or to require any application. He often speaks of the increased ability of seeing objects on his right by the aid of this eye, the vision of which he thinks is improving. He is, however, obliged to cover it when exposed to a strong light, an intolerance

which must be owing to the continued absence of it, and will gradually abate. The eye is straight, and the axes of the two parallel, except when he is looking far to the right, when the right eye inclines a little to the outer canthus. He returns home, with direction to close the left eye occasionally, and exercise the right, especially in the rotation of it inward; a motion which he can perform to a much greater extent than could be expected after the division of these two muscles.

Nov. 18th. I have not seen Mr. S. since Oct. 27th; but now learn, from his father, that the eye is perfectly straight, and more tolerant of light, though still red at the inner corner.

March 20th, 1841. Now the eye is perfectly straight, and its motion natural. Vision has very much improved, though not having seen him, I do not understand to what extent.

V. *Division of Internal Rectus*.—Nov. 5th, 1840. Miss M., æt. 24, of Boston, 17 years ago had measles, followed by disease of the eyes, after which it was observed that both eyes squinted, the right very badly. Her mother thinks, that in consequence of close application as a pupil, and afterwards as a teacher in school, the squint has been gradually growing worse. Now the right eye is turned so far in, that the edge of the cornea is usually hidden at the inner canthus, though it can be brought out at pleasure. Vision from this eye is not so good as from the left.

Drs. Perry, Wiley, Bartlett, Bethune and Dorr

were present. The muscle was divided far back, and the eye immediately became straight. In this case I used for the first time a curved knife, instead of a straight one, and found it preferable, inasmuch as a larger incision may be made with one cut, and when the lid is raised without a speculum, the curved knife is brought out at the upper part of the incision without interfering with the finger of the person who raises the lid.

6th. A slight tendency outward in the right eye, which may yet be turned in by an effort of the patient. Very little pain, but a heavy sensation in the eye. To-day the eye operated on to be turned in as far and as often as possible.

7th. Eye straight, and to be left to itself uncovered. Double vision yesterday, and occasionally to-day.

17th. A slight inclination inward. Left eye to be bandaged, and the right turned forcibly out.

24th. The eye is now again straight, and has been so since last date. The wound in the conjunctiva is nearly cicatrized.

March 17th, 1841. Left eye perfectly straight ; right in certain positions, when looking far toward the left, slightly inverted. Vision much stronger.

When speaking of an eye as perfectly straight, it is not meant that looking in some one direction, as, for instance, far to the right or left, a trifling want of correspondence in the axes of the eyes may not be detected by a close observer ; but that, looking as the person ordinarily does, at objects in front of him, the

cornea is midway between the inner and outer canthus, looking forward.

VI. *Division of Internal and Superior Rectus, and a portion of Inferior Rectus.*—Nov. 30th, 1840. Miss B., of Boston, æt. 25, in early childhood had hooping cough, during which she acquired a convergent strabismus of the right eye, which has been somewhat aggravated of late. Now, the pupil of this eye is nearly hidden at the inner canthus when she looks forward with the left, and on closing the left, it can be turned outward very little beyond the centre of the orbit. When both eyes are open, and she attempts to look toward the right with the right eye, the left is turned far in. Vision with this eye is imperfect, and when reading she is in the habit of covering it with her hand.

Drs. Shattuck, Sen. and Jr., Dr. Doane, Dr. J. Sargent of Worcester, and Mr. Stone, being present, the globe was everted by means of the double hook, and the internal rectus divided posterior to its tendon, together with some exceedingly thickened cellular tissue. No change ensued in the position of the eye, except that she could turn it out more easily than before. I therefore made a division of the superior rectus and a portion of the fibres of the inferior rectus, taking care thoroughly to separate from the sclerotic all adhesions of cellular tissue. There was now a very slight improvement as to its ordinary obliquity, and an increased facility of everting it. Cold lotion. Both eyes to be covered. The indurated and thickened

condition of the cellular tissue in this case is probably owing to inflammation which she had formerly in this eye.

Dec. 2d. Considerable injection. Very light diet. Sulph. magnesia \mathfrak{z} i.

Dec. 10th. Miss B. has had inflammation, requiring a continuance of low diet and the application of leeches. There is apparently but little if any change in the position of the eye.

17th. Since last date there has been a gradual but very great improvement, so that now the squint is very much less than it originally was, though not wholly removed. Probably the improvement did not take place earlier, in consequence of the necessity of keeping the eyes covered for an unusual period after the operation. This is the only case in which any active inflammation has followed, and it is in this attributable partly to the extensive dissection, and partly to the double hook—the use of which, I am satisfied, from this and two preceding cases, very much enhances the pain of the operation, and is after a little practice quite unnecessary for the convenience of the operator. There is no essential improvement of vision, except inasmuch as the eye can be more easily turned to objects on the right.

VII. *Division of the Internal Rectus of both Eyes.*
—Dec. 26th, 1840. Miss P., æt. 21, of E. Boston, at six months of age had lung fever, followed by a slight inflammation of the eyes, which lasted for some time, and on recovering from it, she was observed to

squint, sometimes with one eye and sometimes with the other. Now the inversion of both eyes is about equal, the affection alternating from one to the other, and the pupil of one being carried nearly to the inner canthus, when the other is looking straight forward. Vision is not distinct with regard to distant objects, and in the ordinary use of them, the eyes are quickly fatigued. The vision of the left eye being, as she thinks, less useful to her than that of the right, it is decided to operate on this eye first, though I cannot myself discover the least difference in the eyes, as to the degree of the strabismus, or its frequency.

Dr. Z. B. Adams, Dr. Dale, and Dr. Davis of Portsmouth, being present, the internal rectus of the left eye was divided, about a line from its tendon. The eye immediately became straight—and could be moved but very little toward the inner canthus, the right eye being inverted as usual when the left is in this position, although I think not quite so far as before. Both eyes to be closed, and the left wet with a compress dipped in cold water.

27th. Position of eyes as yesterday. Miss P. wishing to resume her duties as an instructress, it is concluded to operate on the right eye to-morrow.

28th. With the assistance of Dr. Dale the internal rectus of the right eye was divided at its tendinous part. The obliquity was instantly lessened, but not wholly removed, from this eye. Both eyes to be covered and kept cool with wet compresses.

Jan. 4th. The eyes have been opened for a few

days past, there being but little injection of either eye. The position of the left eye perfectly natural, that of the right a little inclined inward. Miss P. states, that after the first operation she had double vision, and all objects were distorted by having their horizontal dimensions enlarged. After the second operation, near objects were trebled, and distant ones quadrupled. When this multiplication of images had ceased, all objects seemed to present themselves diagonally to her view.

March 15th. Miss P. informs me that her vision is much improved, especially as it regards distant objects, and that she can read for a longer time with much less effort and fatigue of the eyes. She now at times sees a repetition of an object, but the occurrence is gradually less frequent, and the false image becomes more and more dim. Since I last saw her the obliquity of the right eye, which then existed, has wholly disappeared, and nothing abnormal can be detected in the position or movements of either eye.

VIII. *Division of the Internal Rectus of both Eyes.*—Jan. 7th, 1841. Mr. P., æt. 28, of Boston, when four years of age began to squint, without any obvious cause, with the left eye. Now the left eye is turned very far in, so that a third of the cornea is hidden at the inner canthus. It can be very fairly everted on closing the right; and when both eyes are directed far to the left, the right squints somewhat inward. He cannot read with the left eye alone. With the assistance of Mr. Stone, the internal rectus of the

left eye is divided far back, together with a portion of subjacent cellular tissue, and the eye becoming immediately straight, with a very slight ability to turn it inward. Cold lotion to left ; both eyes to be closed.

Jan. 8th. Right eye to be closed, and left kept open and turned frequently outward. Has double vision.

Jan. 30th. Both eyes are now nearly straight, but a slight obliquity is observable in each at times. With the view of removing this, Mr. P., at my request, submits to a division of the internal rectus of the right eye. With the assistance of Dr. H. G. Clark and Mr. Stone, the tendon of this muscle is divided, with an improvement in both, though they do not perfectly correspond.

March 1st. Mr. P., soon after the last operation, took a journey southward, and now on his return says that double vision occurs occasionally, but not so frequently as before. When looking at a distant object, if the double vision is experienced, the second or false image is at a greater distance from the true one, than if he were looking at a nearer object ; and if the object be close to him, a portion only of the false image is seen, the remainder of it seeming to be behind the real one. Mr. P. describes the false image as " much more beautiful and delicate than the real one, and resembling rather an exquisitely fine painting than a reality."

March 16th. There has been a gradual improvement, particularly as to the position of the right eye, and now both may be considered straight. The phenomena of illusory vision, above mentioned, now rare-

ly occur, and in less degree. There has been a great improvement in the vision of the left eye, considered separately from the other. He can now read with it, the other being closed.

IX. *Division of the Internal Rectus of Right Eye.*—Jan. 13th, 1841. Mr. W. S., æt. 21, of Roxbury, at four years of age began to squint with the right eye, in consequence, as he thinks, of fits, to which he was subject from his third to his ninth year. When looking forward with the left eye, the pupil of the right is buried at the inner canthus. Vision is so far impaired in this eye that he cannot see to read with it the ordinary print of a newspaper. When the left eye is closed, he has perfect control of the right, and can evert it fully, though it occasions a feeling of dragging at the inner canthus.

Drs. Randall and J. W. Warren, and Messrs. Stone, Prince and Twitchell being present, the internal rectus was divided, at the distance of two lines from its tendon, with immediate removal of the obliquity, the cornea at first, on the division of the muscle, inclining decidedly toward the outer canthus, but in a few moments assuming its position in the centre of the orbit.

14th. The eye has been kept covered with a wet compress, on removing which, he sees objects double.

17th. Inflammation confined to the immediate neighborhood of the incision. No double vision since the 14th. Has in the mean time kept both eyes uncovered. To-morrow returns to his store.

March 15th. Both eyes straight and alike in as-

pect, except that there is greater degree of fulness of the globe apparently at the inner canthus of the right than of the left eye, though this is less evident than it was a month ago. Vision in the right eye has very much improved. He can now see to read with it, at the distance of three feet, the ordinary print of a newspaper, which before the operation he could not read at all. Double vision now occurs very rarely, and is but momentary, the false image being distinguishable from the true one by its faintness.

X. *Division of Internal Rectus of Right Eye.*—Jan. 19th, 1841. Mrs. C., æt. 34, of Hopkinton, at about four years of age squinted without any obvious reason. Now the right eye is turned inward, bringing the cornea quite to the inner canthus, when she looks straight with the left eye. Vision imperfect. She cannot see to read with this eye at all, or to recognize a face. Looking toward the left causes an uncomfortable sensation at the inner canthus of the right eye, in which she thinks there has been an increasing tendency inward for a year past. The left eye is decidedly inclined inward, but not so much as the right. Either eye can be fairly everted at pleasure, on shutting the opposite one.

Messrs. Stone, Read and Coffin being present, the internal rectus of the right eye is divided, with an immediate inclination outward and a gradual subsequent restoration of the pupil to the centre of the orbit.

20th. Eye has been covered and wet with cold water. Now to be uncovered, the left being bandag-

ed, and to be kept for as long a time as possible looking far round to the right, at a patch placed for this purpose on the wall, which direction is given because there seems to be less inclination outward than there was on the day after the operation.

24th. Keep both eyes open and looking in any direction at pleasure, there being now a very little inclination outward. Collyr. sulph. zinci, grs. ii. ; vin. opii, ʒ i. ; aquæ distillatæ, ʒ i. M. Twice daily to right eye.

25th. It is evident that there is less inclination of the left eye than before the operation on the right. Both eyes to be turned frequently toward the left, both acting in unison, but both very slightly inclined to the right. When out of doors to wear within her bonnet, near the edge on the left side, some ornament to which she may frequently turn the eyes.

28th. Both eyes have become straight, and I have decided not to operate on the left eye, which I had at first supposed might be necessary. The strabismus of the left eye was probably sympathetic merely with that of the right.

March 17th. Mrs. C. writes to me, in answer to a letter of inquiry, that the vision of this eye has improved so that she can now "read a few words of coarse print, and recognize a face with the other eye closed."

XI. *Division of Internal Rectus of Right Eye.*—Jan. 20th, 1841. Miss W., æt. 20, domestic, of Boston, at three years of age began to squint with the

right eye, as she supposes from imitating another. Now the right eye is turned, so that in looking forward with the left eye, the edge of the cornea reaches the inner canthus ; and looking toward the left, the pupil is nearly concealed. Vision is impaired in the right eye. She can read but for a few moments with it, and on closing the other eye and using this, a sensation of dizziness is produced. There is a slight inclination of the left eye inward.

The internal rectus was divided far back in the muscle, in the presence of Drs. Homans and Stedman, and Messrs. Prince, Read, Stone, Abbot, Welch and Dean. The eye immediately inclined somewhat toward the outer canthus ; but in a few moments became nearly straight.

23d. Right eye slightly inclined outward. Has double vision after looking at an object steadily for a few minutes. Directed to turn both eyes toward the left at a patch on the wall. Very little redness, even at the inner canthus. Has had no application except cold water. May now resume her usual occupations, taking care occasionally to turn both eyes toward the left.

March 15th. The inclination of the left eye has ceased, and both eyes are straight and move in concert. Vision of the right eye no better than before the operation, except that it is now used constantly without any sensation of dizziness as before.

XII. *Division of Internal Recti Muscles of both Eyes.*—Jan. 25th, 1841. Miss E., of Lowell, æt.

35, when about seven years of age acquired, by degrees, a strabismus convergens, in consequence, as she supposes, of attempting to imitate a twin sister who squinted. Now the pupil of the right eye is hidden at the inner canthus when she looks straight with the left eye, and on turning the right as far out as possible, the left is so far turned in as to cover at the inner canthus a small part of the cornea. Occasionally the convergence seems to be about equal in both eyes. Vision of the right eye is much impaired, so that on closing the left she can see to read very large print but for a few moments. Her ordinary vision is limited to near objects.

Dr. Crane, of E. Boston, and Mr. Stone, being present, the internal rectus was first divided in the right eye, two lines, at least, posteriorly to its tendon, with a slight turn of the eye outward, though she could still turn it somewhat inward, the left eye becoming inverted as usual on turning the other out. After a rest of about five minutes, the internal rectus of the left eye was divided, at about the same distance from its insertion, and with it a few of the inner fibres of the inferior rectus, bringing this eye very nearly straight, with a slight inclination inward, and the right perfectly straight. In both cases the muscle offered more resistance than usual to the scissors, and indurated cellular tissue in connection with the muscle and globe required to be divided. Both eyes to be closed and covered by compresses dipped in ice water.

Jan. 27th. Slight injection of the right, considera-

ble of the left eye. Sulph. magnesia $\frac{3}{4}$ i. The slight inversion of the left eye, which was observable immediately after the operation, has disappeared, and the position of both is central. She speaks of a great gain in her vision. Continue application of ice water as before.

29th. Eyes to be uncovered and used together. Occasionally one is to be closed, the finger pressed gently between it and the nose, and the opposite eye rolled forcibly outward.

Feb. 27th. Slight injection only in either eye; incision fully united, and both eyes perfectly straight and moving in perfect harmony. Vision is very much amended, especially as regards distant objects, while near ones can be looked at steadily, with much less fatigue than formerly.

March 20th. Eyes straight, as at last report.

XIII. *Division of Internal Rectus of Left Eye.*—

Jan. 29th, 1841. Mr. S. C., æt. 18, of Charlestown, squinted at two years of age, in consequence of a fit, as his parents supposed. He had been troubled with worms for some time, and spigelia was administered freely. Now the left eye is turned so far in, that the pupil occasionally lies at the inner canthus, that is, on looking far to the right. Making an effort to look toward the left, the right eye turns in somewhat. Vision has, during his remembrance, been very imperfect from the squinting eye, and he thinks that for a year past it has essentially lessened. He now can see a person with this eye, the other being closed, at the

distance of three feet, but not farther, and if this effort is continued for two or three minutes, the eye becomes suffused with tears, and pain is experienced at the inner canthus.

Drs. G. Parkman, Ball, and Moriarty, Henry Rice, Esq., and Dr. Bemis of Charlestown, being present, the internal rectus was divided in the left eye, just posterior to its tendon, with the assistance of Messrs. Stone, and Prince of Salem. An immediate restoration of the cornea to the centre of the orbit took place, though a power remained of turning it inward to some extent. In this case the cellular tissue below and on each side of the muscle was considerably thickened, and being taken up by the blunt hook was divided, at the same time with the muscle. Although the division of the cellular tissue is complete and extensive on each side of the muscle, and the pupil is exactly in the centre of the orbit, the eye can be turned as far toward the inner canthus as is common in a sound eye, probably from the action of the inner fibres of the superior and inferior rectus. Notwithstanding this unusual control over the motion of the eye inward, I did not think it advisable to divide a portion of either of these muscles, inasmuch as he could turn the eye freely to the outer canthus, and from his youth and healthfulness the external rectus may be expected soon to obtain a sufficient control, after a part of the antagonizing force is removed.

Jan. 30th. No pain or injection. Cold lotion to be discontinued, except occasionally. The right eye to

be closed by a bandage, the left to be kept open as much as he finds it comfortable to do so, and to be frequently turned forcibly toward the outer canthus.

Feb. 5th. The cut edges of the conjunctiva are nearly united. Vision somewhat improved. For three days after the operation he had double vision, and it still occurs at distant intervals.

March 14th. Both eyes are now perfectly straight, unless he looks far to the left, when the right eye turns rather nearer than natural to the inner canthus, but not so far in as before the internal rectus of the left eye was divided. Vision of the left eye very much benefited. He can now see with it at the distance of twenty feet, as distinctly as he could before the operation at the distance of three.

March 27th. As at last report, except that the occasional inversion of the right eye is much less perceptible.

XIV. *Division of Internal Rectus of Right Eye.*—Feb. 6th, 1841. Miss W., æt. 18, of Boston, when four years of age, without any assignable cause, began to squint inward with the right eye, the convergence being slight at first and gradually increasing. The pupil is now, when she looks forward with the left eye, nearly hidden at the inner canthus, but occasionally, when looking toward the right, this eye appears to be straight, and the opposite one slightly turned in. She cannot turn either eye fully to the outer canthus, the other being closed, and cannot see with the right eye to read.

Dr. Z. B. Adams of this city, Dr. Wildes of New Ipswich, and Mr. Stone of Salem, being present, the internal rectus was divided, and the eye at once inclined a little outward, but in a few minutes gained the centre of the orbit, the obliquity of the other eye becoming at the same time more marked.

15th. Wound nearly healed. Miss W. had double vision very seldom for two or three days after the operation, but not at all of late. The right eye is perfectly straight, and the slight inclination of the left has been gradually lessening, she having been directed to look at a patch on the wall placed as far on her left as she can see it.

March 16th. Both eyes straight, as it appears to me, though Miss W. says that the left occasionally turns a little inward. The vision of the right eye has greatly improved since the operation. She can now read perfectly well with it, and considers it as good as the other eye.

XV. *Convergent Strabismus of the Left Eye only*
—Division of Internal Rectus Muscle of both Eyes.
 —Feb. 10th, 1841. Miss B., æt. 15, of Chelsea, 11 years ago fell and struck the upper part of the nose, causing a dark swelling on it. In a week after the accident it was observed that the left eye turned in. The squint is not extreme, the whole cornea being at all times visible. When looking far to the left, the right eye is observed to turn in very slightly. On closing the right, the motions and position of the left

are natural. Vision is impaired, so that she cannot read with the left eye.

Dr. Dale and Mr. Wales assisting me, the internal rectus is divided in its muscular texture, and extensive adhesions of thickened cellular tissue carefully separated, the eye becoming more nearly straight, but not perfectly so, except when the right is closed. Left eye to be kept wet with snow water during this afternoon and evening, and both eyes closed.

11th. Right eye to be bandaged, and the left used exclusively, there being no pain in it, nor any injection except at the inner canthus.

17th. Has kept the right eye closed, and used the left alone since last date, and with some improvement, there being now less disposition in this eye to turn inward, except when a strong effort is made to look far to the right.

March 10th. No further amendment of the squint has taken place, the eye being precisely as at last report. The squint is about one half as great as it originally was, and, considering the very free and thorough dissection made of muscle and cellular tissue, can be accounted for only by supposing it to depend upon a sympathy with the other eye, which, as was before stated, when looking far to the left, turns perhaps somewhat nearer to the inner canthus than natural. It, however, is by no means distinct, and at all other times this eye is perfectly straight. With the hope, therefore, of removing the obliquity of the left eye, I determined to divide the corresponding muscle of the right,

which is apparently perfectly normal in its position and movements—having observed, in some former cases, that a slight obliquity remaining in one eye, after an operation, was removed by dividing the corresponding muscle of the opposite eye, which had been inverted in a less degree, and having also seen this same practice spoken of by an English operator.

Drs. Eddy and Tuckerman being present, the tendon of the internal rectus of the right eye was divided near its insertion, the adhesions of cellular tissue being kept, as far as possible, entire. The eye immediately inclined a little outward, but upon removing the bandage from the left eye it regained the centre of the orbit, while at the same time the obliquity of the left eye had completely disappeared, leaving both eyes straight and uniform in their movements. Both eyes to be kept open.

March 14th. No injection beyond the immediate limits of the incision. Eyes perfectly straight.

XVI.—*Division of the Internal Rectus of Right Eye.*—Feb. 15th, 1841. Miss S., æt. 15, of South Boston, began at four years of age to squint with the right eye, as her friends suppose from imitating some of her schoolmates. The pupil of the right eye is turned very nearly to the inner corner, when she looks straight forward with the left eye. By an effort of the will she can turn the right eye out, when the left turns farther in than natural, though not so far as the right. Vision of the right eye is somewhat impaired. She can distinguish faces with it, but cannot read.

With the assistance of Drs. Dale and H. J. Bigelow, the internal rectus is divided, and the eye immediately becomes straight, though I do not observe the vibration toward the outer corner which is often seen.

17th. Has had double vision occasionally, except on one day, yesterday, when I had the left eye closed with a bandage for the purpose of making her keep the eye turned as far inward—that is, in the direction of the former squint—as possible. This plan was adopted in consequence of a slight tendency of the eye outward. To-day both are left open. No injection of the eye, except at the inner canthus. No disposition of the right eye outward.

March 9th. A small granulation at the inner canthus, which is nearly removed by the closing together of the conjunctiva, and hangs by a little pedicle, is snipped off. Very little injection at the inner canthus. Eyes perfectly straight. Miss S. does not observe that the vision of this eye, separately, is improved since the operation, though both eyes being directed to one object, the amount of useful vision is of course greater.

XVII. *Division of Internal Rectus of Right Eye.*

—March 3d, 1841. Master M. W., æt. 14, of East Boston, when three years of age, being one day in an unusual state of hilarity, laid himself down upon the floor, kicking and screaming apparently for joy. Within ten minutes after, the mother observed that the right eye was turned in, and it has so continued since that time. The squint is not extreme, no part of the cornea being hidden except when he looks with both eyes far

to the left. Vision is very nearly lost in this eye, he having barely a perception of light with it.

Dr. J. F. W. Lane, Dr. Mason of Bangor, and Mr. Stone, being present, the internal rectus was divided near its tendon. The eye became immediately straight, while the left one seemed to be slightly turned in.

5th. He has had both eyes covered ever since the operation. On removing the bandage he finds that he can see his fingers with the right eye. This improvement of vision cannot be ascribed to the mere bringing of the eye into a position where it can be used, inasmuch as but forty-eight hours have elapsed since the operation, and during that time both eyes have been covered, and if he had at any time occasion to see, he has uncovered the left. May not the loss of vision in this case have been caused by a compression of the optic nerve from the spasmodic contraction of the internal rectus, and an unyielding condition of the others; and its restoration be owing to the relief from this compression consequent upon the division of the muscle? The obliquity of the left eye is now less than it was immediately after the operation.

15th. There has been a still further improvement of vision in the right eye, with which, he says, he can now see as well as with the other. He can, in fact, distinguish faces with this eye, but cannot as yet see to read with it. He does not remember having had any double vision.

XVIII. *Division of Internal Rectus of Left Eye.*
—March 5th, 1841. Miss F., æt. 18, of Wayne,

Me., when seven years of age, being at school, was taught by her playmates to put her finger on the nose between the eyes and endeavor to look at it, by which process she acquired a squint inward with the left eye. In a few days, having discontinued the habit which produced it, she found that the eye became straight again, although ever after, when fatigued with bodily effort, or when the eyes had been used a long time, the squint temporarily recurred. About ten years ago she had typhus fever, and during her convalescence, on looking one morning at a bright sun, she felt that her left eye turned in towards her nose. Great intolerance of light and severe pain in the eye succeeded. From these symptoms she obtained relief in a few weeks by the application of leeches, blisters, &c., the squint continuing unaltered. Now the squint is considerable, the pupil being occasionally carried quite to the inner canthus. By an effort of the will the eye can, however, be turned fully out to the outer canthus, and when it is in this position the right appears to turn inward. Both eyes, indeed, appear at times to squint inward. Vision is dim with this eye, and the focus of vision is shorter than in the other.

Drs. Bowen and Wigglesworth being present, the internal rectus was divided, the division being made in the posterior part of the tendon. Although the squint was very considerable in this case, I did not divide the muscle, because, in its present condition, it was of recent date, and it might fairly be supposed that the abductor muscle possessed very nearly its original

power of contraction. The eye became immediately straight, the right somewhat inverted, though much less so than when, previous to the operation, by a voluntary effort the left eye was brought into the centre of the orbit.

8th. Left eye perfectly straight, right more nearly so than when I last saw her; no inflammation. Has double vision very seldom now, although previous to the operation it was almost constant.

15th. Wound quite cicatrized. Both eyes now straight, the obliquity which remained in the right, after the operation on the left, having totally disappeared. No special improvement in the vision of the left separately, but her general vision much better from the cessation of the double vision.

XIX. *Division of Internal Rectus and a portion of the Superior Rectus of Right Eye.*—March 9th, 1841. Mr. F. A. D., æt. 28, of Boston, is doubtful whether his squint was caused by a fracture of the skull at three years of age, or was acquired by attempts to imitate a playfellow. He is confident that he did not squint previous to the accident by which the skull was fractured, but has no distinct recollection of squinting earlier than his fifth year. Now the left eye is inverted so far that the pupil is hidden at the inner canthus. By closing the right eye he can bring the left out not quite to the centre of the orbit, but can by no effort evert it at all towards the outer canthus. This effort to evert the eye is attended with a feeling of tension and pain at the inner canthus. Vision is very

indistinct with this eye, and although by closing the other eye he can at first dimly distinguish one thing from another, in a minute or two they become blended, and he loses all perception of them. There is near the centre of the cornea a slight opacity, which, as it covers chiefly that part of the pupil which is toward the outer canthus, cannot, I conceive, be the cause of a convergent strabismus. When the left eye is brought as nearly straight as possible, the right turns slightly in.

With the assistance of Drs. J. F. W. Lane and Tower, the internal rectus was divided as far back in the muscular texture as possible, together with a few of the inner fibres of the superior rectus, with the instant removal of the squint, and complete restoration of the power of everting the eye freely to the outer canthus, though it can still be turned at pleasure quite as far inward as most healthy eyes. Both eyes to be closed, and the left covered with a compress dipped in ice water frequently.

10th. Right eye to be closed, and the left used exclusively.

13th. Had some uneasiness in the left eye on the day that it was first uncovered and used alone; this has subsided, and he finds that the eye is much stronger as regards the sight, than before the operation. He enjoys now, for fifteen minutes, the same indistinct vision which before the operation lasted not more than one, the right being closed. Very little injection. Continue to keep the right eye shut and the left open.

16th. Eyes straight. He thinks the left is daily ac-

quiring strength. Has been out of doors occasionally for three days past, keeping the right eye closed always.

XX. *Division of Internal Rectus of Left Eye.*—March 9th, 1841. Miss S., æt. 19, of Kingston, N. Y., has squinted with both eyes from birth, as she supposes. The inversion is slight and about equal in both, but perhaps rather more frequent in the left than the right. Vision of the left eye is very imperfect, so that she cannot see to read or sew with it. The globes are exceedingly small, and present, when straight, very little but the cornea between the lids.

Dr. Richardson and Mr. Stone being present, the tendon of the internal rectus of left eye was divided, with the restoration of the cornea to the centre of the orbit. Miss S. immediately observed, before the bandage on the other eye was removed, that she could see much better with this eye. Cold lotion, and both eyes to be closed.

16th. The left eye is nearly straight, and the right usually somewhat inverted. Vision has improved so much in the left eye, that she can now read and sew with it better than with the right.

17th. The left eye a little inverted occasionally when she looks forward with the right. At other times the right is inverted, and sometimes both may be made to appear equally so.

With the assistance of Messrs. Stone and Moreland, the tendon of the internal rectus of the right eye was divided. In consequence of the extreme smallness

and sunken location of the eyes, I found it convenient to open the conjunctiva with scissors, rather than the knife which is ordinarily preferable. The right eye inclined outward, and the left became straight. Cover both. Cold lotion to right.

18th. Inversion of right less manifest than yesterday. Leave both eyes open.

22d. Eyes perfectly straight, and motions corresponding.

XXI. *Division of Internal Rectus of Left Eye.*—March 9th, 1841. Miss C. M., æt. 15, domestic, of East Boston, thinks that when very young her eyes began to turn inward, owing to wearing her hair over them. Both eyes now turn inward alternately, and vision is in both equally indistinct. It is difficult, indeed impossible, to decide which is *the* squinting eye. The squint is not extreme, the sclerotic being visible in both between the cornea and inner canthus.

Drs. Crane, J. F. W. Lane and Tower being present, the internal rectus of the left eye was divided close behind its tendon. This eye inclined for a few minutes outward, but finally assumed a central position, the right turning in, as usual when the left is straight. Both to be closed, and the left covered with compress dipped in cold water. Sulph. magnesiæ ʒ i .

11th. The left eye straight, the right much less inverted than just after the operation. Use the left eye only, leaving the right bandaged. May resume her occupations.

15th. Both eyes now so nearly straight that I con-

ceive the operation, which I expected to do upon the right eye, unnecessary. Vision as before the operation, except that there is less fatigue in using the eyes, and she can more readily see objects on each side.

XXII. *Division of the Internal Rectus of Right Eye*.—March 12th, 1841. J. G., æt. 5, of Boston, two and a half years since, while suffering from hooping cough, was observed to squint inward with the right eye. As his health was re-established, the squint, which at first was extreme, gradually lessened, until, rather more than a year ago, it reached the position in which it has since remained. The inner edge of the cornea lies nearly at the inner canthus, when his left eye is directed forward. The left eye being closed, the position and movements of the right are correct.

Drs. G. Bartlett, Cotting, Wigglesworth, and Mr. Mears being present, the internal rectus of the right eye was divided near its tendon. The eye at once inclined a little toward the outer canthus, but on removing the bandage from the left eye, came back to the centre of the orbit. In order to avoid any unto-ward movement, the child was placed for the operation horizontally. It was not necessary to use the double hook, the fine one, with which the conjunctiva was raised, affording sufficient control of the globe to pass the blunt hook under the tendon. Both eyes to be covered, and the right wet with cold water.

13th. Cover left eye, leaving right open.

15th. When the left eye is closed there is a slight inclination of the right outward, which disappears on

opening the left. The right can be turned in at pleasure. Leave both eyes open.

17th. Eyes straight. Wound cicatrized. Slight redness at inner canthus only.

XXIII. *Division of Internal Rectus of Left Eye.*—March 26th, 1841. Miss G. of Holliston, when three years of age was subject to an affection of the head, in consequence of which, it is supposed she then began to squint with the left eye, the pupil of which now often lies at the inner canthus, when the right eye is straight. The right eye also is affected with the strabismus, but in less degree. The squint has for five years past been as at present, some amendment having previously taken place. Health is never firm. Vision of the left eye considerably less than of the right. She cannot read with it alone.

Drs. Buck, Sen. and Jr., Dr. Oliver and Mr. Moreland present. The internal rectus divided near the tendon. The eye became at once straight, and cannot be turned in at all. The inversion of the right more manifest. Cold lotion during the day to the left eye; both closed.

April 3d. Left eye perfectly straight. Right less inverted than before. Has recovered power of turning the left inward. Vision so much improved that she can now read with this eye for a short time.

XXIV. *Division of Internal Rectus of Left Eye.*—March 26th, 1841. R. S., æt. 25, of Quincy, at 10 years of age had an inflammation of the eyes, which resulted in an extensive opacity on the lower

part of the cornea of the right, an adhesion of the iris to it, and an almost complete obliteration of the pupil. She has been for several years an invalid, and from her 17th to her 22d year, was subject to fits. Four years ago she began to squint with the left eye, probably in consequence of the fits with which she was then afflicted. The squint has been increasing until this time, when the pupil is usually more than half hidden at the inner canthus. She everts it not quite to the centre of the orbit, but can retain it in this position not longer than four or five seconds, and this effort to evert the eye is accompanied with the tremulous motion termed nystagmus, which is also recognized at times when no such effort is made. The right eye is also affected with the nystagmus, but does not appear to be strabismic. Vision is necessarily exceedingly imperfect, but still such that she can render herself useful in the family. Owing to the lesions of the right eye above mentioned, she sees principally with the left, and through the pupil of this but a few oblique rays can at any time enter.

Dr. Foster and Mr. Moreland being present, I divided the adductor muscle of the left eye as far back as possible. The eye became straight, and she could evert it nearly to the outer canthus. Eyes to be closed, and the left wet with cold water during the remainder of the day.

April 2d. Eyes straight. Says she can see very distinctly in all directions. The nystagmus or tremulous motion is less than before, but still evident.

XXV. *Division of Internal Rectus*.—March 25th, 1841. Mrs. H., æt. 23, of Boston, when three years of age received a violent blow on the back of the head, and was immediately after seen to squint with the right eye, the inner edge of the cornea of which now reaches to the inner canthus. It can be readily everted on closing the left eye, of which also there is an occasional slight inversion. Vision of the right eye not so distinct as of the left. Drs. Salter and J. F. W. Lane, and Mr. Moreland, being present, the muscle was divided just where it becomes tendinous. The eye immediately inclined a little outward, but on removing the bandage from the other eye, it assumed the centre of the orbit, while the left seemed slightly to turn in. Both eyes to be covered, and the right wet with cold water.

26th. Cover left eye, and use the right only.

30th. Both eyes straight, the slight inversion of the left having disappeared.

April 3d. Position and motion of both eyes perfectly correct and uniform.

XXVI. *Division of Internal Rectus*.—April 5th, 1841. Master S., æt. 13, of Brookline, was born with a decided inversion of the right eye. Now there is a strabismus inward and slightly upward in the right eye, and also a trifling obliquity of the left eye. With the right eye alone he cannot see to read, and using the left for some time causes a sense of weariness, and suffusion in the right. The right eye can be everted somewhat beyond the centre of the orbit

on closing the left. Dr. Wild of Brookline, Dr. D'Wolf of Bristol, and Mr. Stone, present. The internal rectus divided far back, together with much thickened cellular tissue. The eye can immediately be everted fully, and rests in the centre of the orbit. Cold lotion during remainder of day, both eyes being closed; to-morrow left eye to be covered, and right used independently of it.

7th. Eyes straight. The left eye to be still covered, and the right directed outward at a patch on the wall.

STRABISMUS DIVERGENS.

Division of the External Rectus Muscle.—March 6th, 1841. Mr. L. B., æt. 21, of Germany, when three years of age was attacked with smallpox, in convalescing from which he had an inflammation of the left eye, which lasted for six weeks, at the expiration of which time the eye was found to squint outward. Now the divergence is variable, when his attention is directed to it slight, and at other times decided, the cornea approaching the outer canthus within a half of a line when he looks straight forward with the right eye, and being partially hidden under the upper lid when he looks toward the left. Vision in this eye is very nearly as good as in the other. The squint in this case is somewhat upward as well as outward.

Drs. J. B. S. Jackson, Wigglesworth, O. W. Holmes, Bowen and Davis being present, the division of the

external rectus was effected in the same manner as that of the internal rectus in the preceding cases, except that the incision of the conjunctiva was made a little farther from the cornea, in order to bring the cicatrix under the lids. The tendon was divided near its insertion, and just beneath the incision of the conjunctiva, because, although the obliquity was considerable, the muscle being antagonized always by the rectus internus, and occasionally by the two oblique muscles, I was desirous of leaving as extensive adhesions of cellular tissue as possible between the muscle and the globe. The pupil instantly regained the centre of the orbit, and he had double vision. On turning the eye outward, which he has still the power of doing about as far as natural, the upward inclination is not observed. The sound eye was not bandaged during the operation, as the left eye was inverted more completely when it followed the eversion of the right, than when it was left to act independently of it. Both eyes to be closed, and the left wet with iced water.

7th. Both eyes perfectly straight, and moving harmoniously in every direction. Apply cold lotions occasionally, and at other times keep the right eye covered, and use the left independently of it.

16th. For a week past he has been out, and has had both eyes open as usual. They continue to be perfectly straight. He is conscious of an improvement of his general vision.

ANALYSIS OF FIFTY CASES.

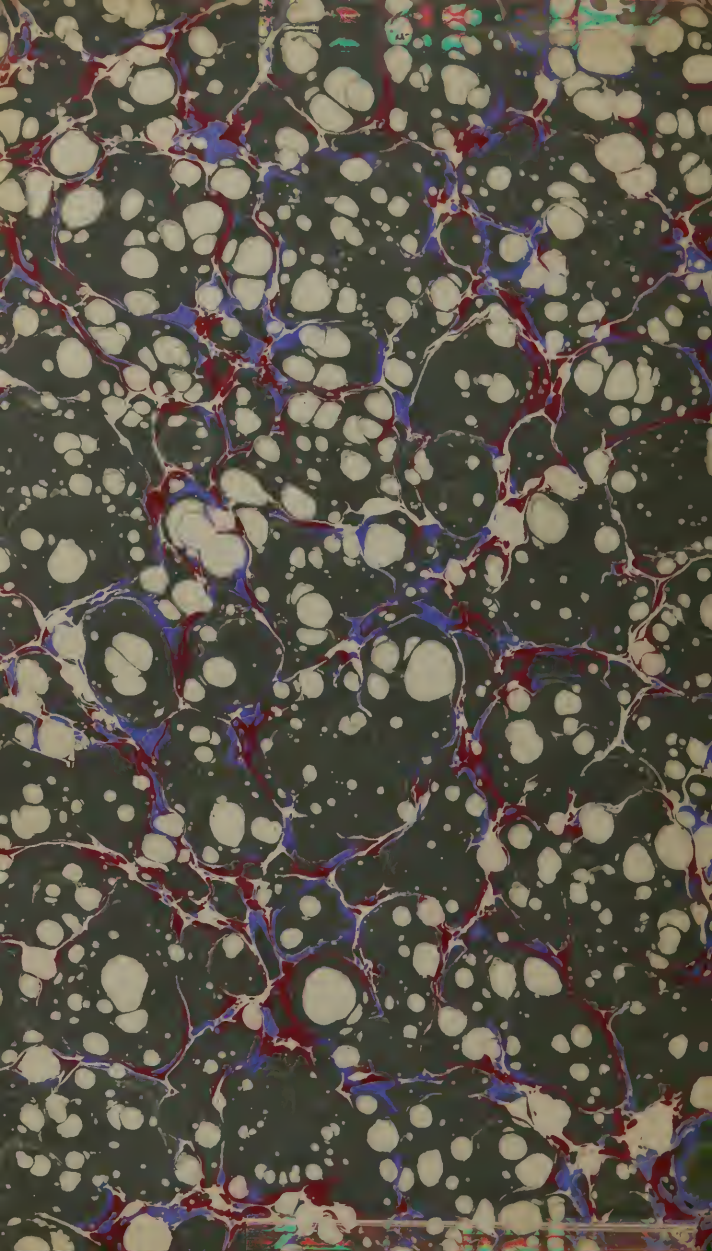
Females	-	-	-	-	31	
Males	-	-	-	-	19	50
Convergent	-	-	-	-	48	
Divergent	-	-	-	-	2	50

One eye only squinted and was
operated on in - - 36

Double,—that is, requiring the
operation on both eyes, in - 14—50

Three cases are supposed to have been congenital, and the squint was observed previous to the eighth year in every case but two."

The causes assigned were as follows: Fits, 6. Inflammation, 5. Hooping cough, 5. Chorea, 1. Blow, 2. Fracture of skull, 1. Imitation, 11. Unknown, 19.



The background of the entire image is a traditional marbled paper pattern. It features a dense, irregular arrangement of large, light-colored (cream or off-white) circular spots, often referred to as 'stones' or 'cells'. These are set against a dark, almost black, background. Interspersed among the dark areas are thin, branching veins of a deep red or burgundy color, and occasional veins of a vibrant blue. The overall effect is a complex, organic, and visually rich texture.

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